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SUBWAY DEVELOPMENT.

At the World's Fair, in a comparatively obscure exhibit, was a miscellaneous collection of articles, including a plow, a length of telegraph cable and some old telegraph instruments. These represented the first efforts put forth in this country in placing electrical wires under ground, and were used by no less a personage than Prof. Morse himself. The plow was used to open a trench in the ground into which the inadequately insulated wires were placed as part of the now historic telegraphic circuit between Baltimore and Washington, and the instruments were some of those used on the aerial circuit after it was finally established. It is not generally known that Prof. Morse at first favored placing his telegraph wires under ground, and it was not until an actual test had proved the futility of such a course that he resorted to the aerial suspension method. The failure of the underground plan was due entirely to the inferior and inadequate insulation employed, which in this case consisted of wrapping the wires with cotton, painting them with shellac and then drawing them into a leaden tube. The experimental underground section was five miles in length, and the number of wires placed in the tube was four.

The underground conductor problem was not again taken up in this country until the early eighties, when the same influence that caused Morse to abandon his underground plans and place his wires overhead manifested itself, but in the reverse order. Overhead electric lines had become so numerous in New York City that it was made compulsory by the Legislature to place them underground, and the subsequent experiences are probably remembered by many of our readers. Great activity in subway construction existed for several years and various systems were laid down. No prior experience could, however, be referred to for guidance and the work was therefore necessarily of a tentative character. Yet the pioneers built better than they knew, and it is a remarkable fact and one reflecting great credit upon the early engineers that the same general types of conduit systems that were laid down at the very beginning of the art are still copied in the underground construction work of to-day.

The growing necessity for placing electrical conductors under ground is evidenced by the fact that subways are now used in at least 50 cities and towns in America. One of the most important problems yet to be solved in this direction is the laying of underground telegraph and telephone lines between cities and towns. The necessity for this has more than once manifested itself when telegraph and telephone wires between important commercial centres have been prostrated by sleet or wind storms. These disasters do not occur with such frequency as formerly, because of stronger construction of the lines, but however strongly a line may be built it is always exposed to these dangers, the existence of which places greater emphasis upon the desirability of having at least the trunk lines underground between important cities.

FOR THE ADVANCEMENT OF SCIENCE.

In another column of this issue are published a few more details concerning the bequest of the late Swedish engineer, Alfred Nobel, of the income of his large fortune for the advancement of science and in the interest of humanity. The will provides for the award of five prizes annually, which it is calculated will amount to about $60,000 each. These liberal rewards will no doubt exercise a healthy stimulus in investigation along the lines prescribed by the will and

encourage many engaged in this work. The conditions of the competition are not yet known here, but that the lists are open to American investigators and scholars is certain, inasmuch as it is expressly stated in the bequest that the competition for the awards shall be open to the world. We hope to see some of our countrymen lead in these competitions and reap the bountiful rewards provided by the deceased distinguished engineer for those who prove themselves worthy of the distinction by their works. None the less worthy of earnest effort, however, are the prizes offered by the Franklin Institute of Philadelphia and those of the Paris Academy of Sciences. Through the Franklin Institute Mr. Uriah A. Boyden, of Boston, Mass., has offered a prize of $1000 to "any resident of North America—including Mexico and the West Indies—who shall determine by experiment whether all rays are or are not transmitted with the same velocity." According to the terms of the competition each competitor is required to submit to the Institute a detailed description of the apparatus, the mode of experimenting and the results obtained before Jan. 1, 1898. The judges will then examine the memoirs and report to the Institute which, in their opinion, is most worthy of the premium. According to the conditions, the name of the successful contestant will not be known, even to the judges, until after the award has been made, and the names of the unsuccessful ones will not be revealed at all. The great scientific importance of the work mapped out by Mr. Boyden, and the stimulation of his generosity, will induce as earnest and enthusiastic work on the part of those within the geographical limitations of the contest as will be exercised by the whole scientific world in reaching after Mr. Nobel's generous rewards. The prizes offered by the Paris Academy of Sciences cover practically every subject of scientific investigation and include the Gaston Planté prize of 3000 francs for an important invention in electricity. Taking all together there are many inducements offered for scientific investigators.

THE BERLINER PATENT.

In a letter which will be found in another column of this issue Mr. Emile Berliner, patentee of the Berliner patent, refers to an editorial which appeared in our issue of Jan. 9, 1897, pertaining to some questions which are likely to be considered by the Supreme Court in its decision of the case of the United States *vs.* the American Bell Telephone Company. Mr. Berliner calls attention to the fact that his application of June 4, 1877, the patent in suit, was preceded by a caveat on April 14, of the same year. Although most of the phases of the telephone situation have been considered in past issues of The Electrical World, the added importance of the subject at this time justifies a thorough and comprehensive discussion. For this reason we have, in other columns of this issue, discussed several of the points in contention, and will here further consider those raised by Mr. Berliner.

The caveat of April 14, 1877, as shown in the proceedings before the Supreme Court, has an important bearing on Mr. Berliner's claim, inasmuch as it gave him precedence over Edison in the Patent Office, a fact of which we took cognizance in the editorial referred to. Although this caveat described a transmitter operating upon the principle of the constant-contact transmitter disclosed more than a year previous in a patent to A. G. Bell, yet Berliner in his application of June 4 states in reference to the invention in suit: "These simple instruments will reproduce any musical sound uttered in the neighborhood of one of them; but for the reproduction of special sounds, such as speech, they are not adapted for the following reasons;"—Berliner then states the reasons why he did not consider his constant-contact transmitter capable of reproducing speech and describes a special make-and-break transmitter which he claimed would transmit speech. On Dec. 8, 1877, Berliner made application for certain improvements in his transmitter and stated in reference to his June 4, application: "Since then [*i. e.* June 4] I have found that when sound is transmitted by varying the intensity of the current without interrupting the same, namely, by merely weakening or strengthening the contact at each vibration and thereby the current, the effect on the receiving instrument is not very strong." It was in consideration of these statements of Berliner made previous to those amendments of his application which unquestionably described the constant-contact transmitter, that we stated: "If Berliner made the discovery that his constant-contact transmitter would transmit speech subsequent to June 4, 1877, the date of his application, he apparently was not entitled to the patent granted him, for meanwhile Edison had disclosed his constant-contact carbon telephone." Mr. Berliner explains these statements in his letter as follows: "The June 4 application was a document garbled through the ignorance in the science of telephony of the clerk who wrote it, and causes are fully set forth and proven in the pend ng suit." We are sorry that Mr. Berliner should feel called upon to expose and prove "the ignorance of the science of telephony" on the part of the unfortunate clerk who drew up Mr. Berliner's application in 1877 for a fundamental patent on telephone transmitters. Certainly an attorney's clerk should have greater foresight.

Mr. Berliner also writes, "I must also take exception to the hypothesis that the microphonic action is necessarily or at all due to the difference in the number of molecules in contact." As stated by Mr. Berliner, this was assumed as an hypothesis on our part, for the simple reason that we had no desire to pose as an authority on a subject which has been the basis for most extended arguments. It is our opinion, however, that Judge Aldrich is quite correct in his contention that both the liquid transmitter invented and operated by Bell in 1876 and the microphone transmitter of Berliner depend for their variation in resistance on the same principle, *i. e.*, on a variation in the number of molecules in contact at the point of variable resistance. This opinion is substantiated by Maxwell's reference to the well-established laws of resistance. "It depends entirely on the nature of the material of which the conductor is composed, the state of aggregation of its parts and its temperature." The temperature changes in the microphone are due to the changes in resistance of contact, not the reverse, and are too slight and too slow to influence the quality of transmission, although they might to a very slight extent affect the volume of transmission as the temperature of the electrodes gradually changed, thus permitting of relatively larger or smaller currents. We may therefore safely say that heat plays no part in the effective action of the microphone. The nature of the material is constant for any particular microphone, while the remaining condition, *i. e.*, the state of aggregation, can only refer to the number of molecules in contact and to their arrangement. In a paper read before the Society of Telegraph Engineers and Electricians in 1883, Prof. Silvanus P. Thompson stated: "It is the opinion of both Mr. Anders and myself that the resistance of contact for telephonic purposes (I am speaking here only of a single contact between two pieces or parts) is determined solely by the number of molecules in contact at the surface and by the specific conductivity of these molecules." Prof. Hughes has taken practically the same position by considering the variation of resistance as due to the variation in the *amount* of contact.

A study of the testimony and arguments in this suit has failed to reveal that the American Bell Telephone Company claims that the microphone of Berliner does not depend on the variation in the number of molecules which take part in the conduction of the current across the variable resistance contact, but rather that a sufficient difference in rigidity of the liquid surface in the Bell transmitter and metallic surface in the Berliner transmitter exists to justify a broad patent to Berliner on a transmitter depending upon a variation in pressure between the electrodes.

The Reasonable Method of Rating and Testing Safety Fuses.

BY FREDERIC A. C. PERRINE.

Engineers are already familiar through the published experiments of Nichols, Jackson, Stein and Harrington with the unreliability of safety fuses, whether they are made of pure metals or alloys when depended upon to rupture a circuit carrying any definite amount of current. Although probably the reasons for variations in the melting current have been long understood, they were first experimentally emphasized by Mr. Harrington and the amount of possible current carried for a very short time deduced by him from a very long and complete series of tests.

At the present time it is unnecessary therefore to repeat such a series of experiments upon any newly designed fuses or to attempt to obtain any more exact results from those already tested, since the same conclusions must inevitably follow from any series of experiments which could be made, and the practical effect would be only to emphasize the fact, which is already known, that it is impossible to construct a fusible link having so small a time function as to protect a circuit from a great rise of current under all conditions. Indeed, it has never been necessary to prove this by an experiment, as the fact is easily deducible from the laws of the production and dissipation of heat in wires and of the rise of temperature due to absorbed heat.

Using the method of Kennelly for obtaining the heat absorbed by a wire in a definite time, we have the heat produced in a wire carrying a current equal to $K I^2 l M/d^2$ where K is the equivalent in units of heat of one watt; I the current; $l M/d$ the resistance of a round wire, l being the feet, d its diameter in mils, and M the resistance per mil foot. In the case of a safety fuse of short length, especially if melted in a short time, the loss of heat by convection is negligible, while the heat lost by radiation is:

$$h = K' (1.0077)^{\theta} [(1.0077)^{t} - 1]$$

where h is the heat lost in one second per unit of surface which is taken as the surface of a mil foot; K' a constant depending upon the character of the surface and the units in which it is measured; θ the temperature of the surrounding bodies; t the temperature elevation in degrees centigrade of the hot body which in this case is a variable. From this we obtain the heat absorbed in a definite time to be:

$$\left\{ K I^2 \frac{l M}{d^2} - K' (1.0077)^{\theta} \left[(1.0077)^{t} - 1 \right] \right\} T$$

where T is the time the current I has been applied.

The heat necessary to melt any metal is equal to $l d \pi w s t'$ where $l d \pi w$ is the weight of the wire, s its specific heat and t' its melting temperature, from which we have, when T is taken as the time necessary for melting:

$$T \left\{ K I^2 \frac{l M}{d^2} - K' (1.0077)^{\theta} \left[(1.0077)^{t} - 1 \right] \right\} = l d \pi w s t'$$

or

$$T = \frac{l d \pi w s t'}{K I^2 \frac{l M}{d^2} - K' (1.0077)^{\theta} \left[(1.0077)^{t} - 1 \right]}$$

In the second member of this equation it is obvious that for any specific case all the quantities are constants with the exception of I, M and t'; t varies continually between a value zero when the wire is carrying no current and the temperature of the fuse is θ, and a value $t - \theta$ at the time of melting. M has correspondingly varying values since it represents the resistance per mil foot at each particular temperature of this range.

In consequence these quantities may be assigned average values without sensible error as the variables are always continuous and between the same limits. Assigning these average values it is seen that the only remaining variable is I and we have: $T = \frac{C}{C' I^2 - C''}$, from which we obtain the current for melting any fuse in a time T to be:

$$I = \sqrt{\frac{C}{TC'} + \frac{C'}{C''}},$$

or that the current tends to vary inversely as the square root of the time and in consequence no definite melting current can ever be assigned unless the time be also given.

It is also obvious from the equation $T = C/C' I^2 = C''$ that in every case there is a minimum amount of current necessary to melt the fuse even in the case of prolonged service, namely, the smallest current which makes the product $C' I^2$ greater than C'' since when $C' I^2 = C''$ the time required for melting is infinite and for smaller values the time T has no real value, or in other words the fuse will not melt however long the current is carried. The minimum value of I for melting which is so obtained is the quantity generally given as the fusing current and is the current given by the equation of Preece, $I = a d^{\frac{3}{2}}$, in which a is a constant dependent, as Feldman has shown, not only upon the material of the fuse, but also upon the length employed and the character of the terminals to which it is attached.

From the experiments already noted which bear out these conclusions there has arisen a disposition among engineers to discredit the use of fuses under all circumstances, some even contending that fuses should only be employed on circuits carrying less than 20 amperes, and only in these cases on account of the extra expense which would be entailed by the use of magnetic cut-outs.

And yet, in spite of this concensus of scientific opinion concerning their unreliability, fuses are continually installed by practical station managers, are approved by the insurance inspectors, and furthermore seem to fulfill their mission with a sufficient amount of reliability to prevent an excessive number of fires due to overheated conductors.

It seems therefore that the experimenters and engineers are at variance in their understanding of the proper use for fuses in circuits; confusion in this matter has perhaps been brought about by the custom of selling fuses on the market with ratings attached either referring to the amount they are destined to carry or to the minimum current at which they fuse in a long time. Constructing engineers are aware that conducting wires are similarly rated and accept the fuse ratings in the same spirit; while those making the fuse wire tests have considered the ratings as referring to fixed values of the melting current.

There is perhaps no one who has been long connected with electrical undertakings but has wondered that, while each lamp connection is carefully fused, the lamp itself is never protected against a rush of current sufficient to destroy its filament, and has questioned the use of this device which appears inoperative. And yet to any one not content with merely puzzling over the anomaly, the usefulness of this fuse and of all fuses has been gradually revealed in the power they have of protecting the wires of the circuit against overheating. This power and this only justifies the continued use of fusible cut-outs in electric circuits; they are not intended to prevent a sudden rush of current and cannot properly be used to protect apparatus liable to damage from such a cause, but as they melt by the retention of the heat, which is generated and not radiated, they may be properly employed in protecting wires which are likely to become overheated and dangerous from a similar cause. At the same time it is not a foregone conclusion that a particular fusible cut-out will satisfactorily protect wires in all locations and under all circumstances. On the contrary it is easy to see that if a fuse be proportioned to prevent overheating in a particular wire suspended out of doors the same fuse would not properly protect the same wire if it were wound into a coil. Experiments are therefore necessary in the proper rating of fuses but the experimental determination of the fusing current in a definite time does not give the required information. What we wish to know is the maximum temperature a wire carrying current and definitely fixed will assume before the fuse which is supposed to protect it becomes melted; that fuse being chosen as the proper one to protect the wire under the given circumstances which will always melt before the wire reaches a given temperature.

The true method of testing fuse wires therefore is to measure the temperature of the wire which is supposed to be protected as the current is increased in the circuit. Kennelly's experiments give for certain particular cases of installation the maximum temperatures attained by copper wires when continuously carrying current and, accepting his recommendation, the proper current for a given wire should be so chosen that double its value does not increase the temperature of the wire more than 75 degrees Fahr. We thus have a basis for choosing the proper fuse to protect the wire against overheating; for obviously this fuse should be one which when continuously heated will melt when the current supposed to be carried by the wire is more than doubled, provided that it may be proved that this fuse will also melt under the influence of a greater current before the temperature of the wire exceeds 75 degrees Fahr. from the heating effects of the same current. A fuse chosen as above

indicated will invariably melt before the wire is overheated if the resistance and radiating surface are such that its gain of heat per unit of current is more rapid than that of the wire it is protecting, as for instance if both fuse and conductor are of the same specific resistance, *i. e.*, both are copper and both are wires; then the size of the fuse must be much smaller than the conductor; its resistance per unit of length is much greater and its radiating surface is smaller; hence it will heat more rapidly than the wire under the influence of a great current and the wire will be protected; but if now the fuse wire be rolled flat until its radiating surface becomes equal to that of the conductor its protecting power is doubtful.

In the experiments that the author has made up to the present time with round fuses of the ordinary fusible methods protecting wires in insulating tubes, it was found that the heating of the wires when the fuses were melted rapidly was apparently much less than when the fuses were melted slowly, which would indicate that the ordinary fusing of wiring circuits was a sufficient protection against the overheating of conductors. At the same time it is not contended that it is possible to prevent even overheating in the coils of electromagnetic machinery by any choice of the ordinary fusible metal links in the common fuse blocks, to say nothing of protection against electromagnetic damage. For these purposes special fuse blocks and fuses must be designed, while probably electromagnetic circuit-breakers will always serve the purpose in a better manner, but it is claimed that for the protection of conducting circuits, in which service they were originally designed and for which they are still generally used, the fusible cut-out will always efficiently protect if it is intelligently chosen.

The Late Alfred Nobel's Bequests to Science.

In The Electrical World, of Jan. 9 last, was published a short paragraph in reference to the munificent bequest to science by the late Alfred Nobel, the distinguished Swedish engineer and chemist. Later information on the subject corroborates the facts already published, and gives further details.

According to *Le Figaro*, of Paris, the provisions of the will relating to the awarding of the prizes are as follows :

The income shall be divided into five equal parts, which will be awarded yearly:

The first to the person who shall have made the most important discovery or invention in the domain of physics.

The second to the person who shall have made the most important discovery or improvement in the domain of chemistry.

The third to the person who shall have made the most important discovery in the domain of physiology or of medicine.

The fourth to the person who shall have produced the greatest work in the ideal sense in the domain of letters.

The fifth to the person who shall have exerted the greatest or the best action for the fraternity of peoples, for the suppression or diminution of permanent armies and for the formation or spreading of Peace Congresses.

The first two prizes (Physics and Chemistry) shall be awarded by the Academy of Sciences of Sweden; that for physiological or medical works, by the Carolus Institute of Stockholm, the literary prize by the Swedish Academy, and that for the spreading of peace by a committee of five members chosen by the Norwegian Storthing.

"It is my express will," says the testator, "that no consideration of nationality should be taken into account in awarding these prizes, so that the most worthy may receive the reward whether he be a Scandinavian or no."

M. Nobel's convertible fortune consists of real property in Paris and San Remo, but for the greater part of securities deposited in his house at Paris, and with bankers, in London, Paris, Berlin, St. Petersburg and Stockholm. It will take some time to find out the exact amount of the bequests, but it is safe to say that it will amount to at least $10,000,000, and that each of the yearly prizes established by M. Nobel will be as large as $60,000. These it is stated by *Le Figaro* are the largest prizes that have ever been established. It remains to be seen what advancement of the objects which M. Nobel had at heart will be attained by so profuse liberality.

Electric Lighting in St. Petersburg.

A company has been formed which made an offer to the municipality to light all the streets of the city with electric lights for the same price that is now paid for the very unsatisfactory lighting with oil lamps.

Convention of the National Association of Manufacturers.

The second annual convention of the National Association of manufacturers held in the new Horticultural Hall, Philadelphia, on Tuesday, Wednesday and Thursday of this week, brought together one of the largest and most representative gatherings of manufacturers ever held in this country. The Association had only about 300 members when it last met in Chicago, but the number now exceeds 900 members, representing a larger invested capital and greater value of product than any other business organization in the world.

This association is composed of business men for business purposes. They are associated for the purpose of extending and widening the avenues of trade and commerce, and to remove obstacles in the way of fair competition in the home markets, and for improving the conditions governing American trade with other countries.

In his annual address the President, Theodore C. Search, of Philadelphia, clearly and ably reviewed the progress of the year, and pointed out the objects of the Association, which are largely the cultivation and extension of foreign trade. The subjects treated in this report are not sufficiently or distinctively electrical to warrant their discussion at much length in a journal like The Elfctrical World. Those of our readers interested in the matter, however, are advised to procure a copy of the report and study it.

The reports of the various committees which have been engaged upon different lines of work were also presented, and these, together with the suggestions made in the president's report, occupied the larger share of the consideration and discussion at the meetings.

On Wednesday forenoon a general discussion took place on the President's address, while at the afternoon session the tariff was the topic which claimed attention. In the evening there was a general exchange of views on the subject of foreign trade and commerce. On Thursday the old officers were re-elected as follows: Theodore C. Search of Philadelphia, president; Robert Laidlaw, of Cincinnati, treasurer; E. P. Wilson, of Cincinnati, secretary.

Invitations were extended to the association to meet next year in Denver, Nashville, Indianapolis, Detroit, Old Point Comfort and Greater New York. Mr. Charles A. Schieren promised that if the meeting were held in Greater New York as cordial hospitality would be shown as had been accorded in Philadelphia, although he appreciated that in this a large contract would be undertaken.

It was finally decided unanimously to meet in Greater New York next year.

On Thursday evening occurred at the Bourse the banquet tendered by the Philadelphia members to visiting members and invited guests. This was an elaborate and elegant affair, about 500 being present. The toasts were numerous and appropriate, and every one at the convention left with the feeling that the National Association of Manufacturers has a useful career before it.

Rubber Exports of Nicaragua.

In the consular reports for January, 1897, Consul O'Hara states that the Presidential decree of July 13, 1896, prohibiting the exportation of rubber from Nicaragua from Jan. 1, 1897, has been amended by Presidential decree of Sept. 22, 1896, so as to permit the exportation of rubber until Jan. 1, 1898. The decree provides that all rubber exported during the year 1897 shall be subject to the payment of an export tax of 4.9 cents in United States currency per 1.043 pounds.

Consul O'Hara also states that rubber growers and others engaged in the business will be interested to learn that a new and less destructive method of getting rubber has recently been discovered. Heretofore the trees have been cut down or the liquid made to exude from incisions at the foot of the tree, but it has been found that the leaves of the rubber tree yield a purer and more abundant supply.

The value of rubber shipped from San Juan del Norte to the United States, during the fiscal year ending June 30, 1896, was $134,584.25.

An Italian Institution of Electrical Engineers.

According to the London *Electrical Review*, "La Associazione Elettrotechnica Italiana" is the title of a new society which has just been formed in Milan. Prof. G. Ferraris, of Turin, has been elected the first president, with Prof. G. Colombo, of Milan, and Prof. G. Mengarini, of Rome, as vice-presidents.

Progress of Electrical Subway Work.

BY WM. MAVER, JR.

It will be remembered that the first general placing of electrical wires of all kinds underground began in this country in New York City in the latter part of 1888 or the beginning of 1889. This was when the hue and cry was raised against overhead wires, and the work of thus placing the wires underground, particularly those of the electric light companies, was necessarily carried out in a very hurried manner. That the work was done in a fairly substantial and successful way is, however, attested by the fact that with scarcely an exception the cables then employed are in operation to-day. The same general types of conduit, manholes, and so forth, as at first adopted are still utilized; the only change in the main construction work being in the matter of the distribution boxes for electric lighting service. These boxes, which were of the ordinary cast iron pattern shown in Fig. 3, were found imperfect in several respects, namely, as to depth, rigidity, etc., and in consequence they have been almost entirely replaced by what are virtually miniature manholes.

One of these latter is outlined in Fig. 4. It is about two feet square; and is provided with an inner and outer iron cover as marked. The main body of the box is of brick, built upon a cement bottom. A cast-iron head *H* is set upon the brick foundation. A curved flange *f* runs around the base of this head, on the inner side, and the inner cover rests on this flange, a rubber gasket intervening for the purpose of keeping out of the box proper any surface water that may enter through the outer cover, which is not water tight and is flush with the street paving as required by city ordinance. Of course the tendency for water to enter the box would be much lessened if it were permissible to allow the head of the box to project somewhat above the paving. A small tube shown at left of figure in some instances leads from the flange to a space below the cement floor to drain off the surface washings. The main line ducts are outlined end on in Fig. 4. The lateral or service duct is shown at *D*. The inner cover is held tightly down upon the gasket by the bar and screw bolt shown. The dimensions of the box are indicated. The cast iron head, inner and outer covers and the bar and bolt are shown separately in Fig. 6. The regular manholes of the drawing in subways vary in size from 6 to 12 feet in depth, and 6 to 8 feet in width. One of these manholes is illustrated in Fig. 1.

The foregoing relates to the subways set apart respectively for

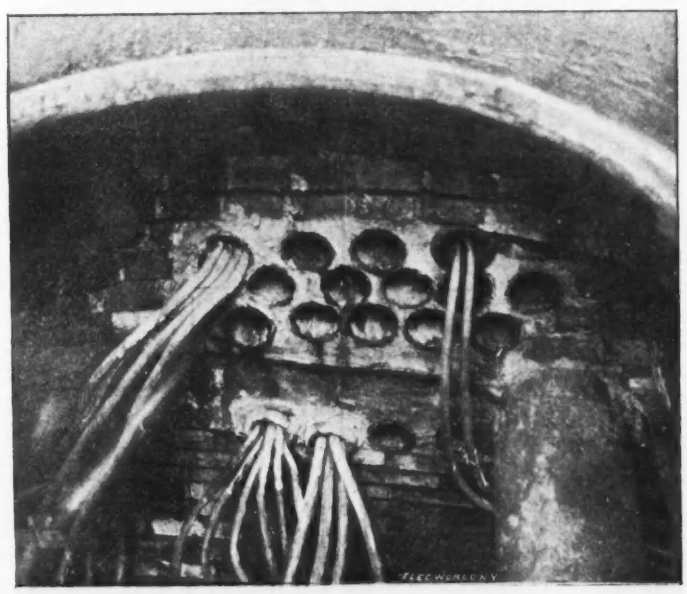


FIG. 1.

what are, in New York City, termed the "high tension" electric light service, and the telephone and telegraph service. It will be understood that the electric light and the telephone circuits are kept strictly separate, the respective ducts for each service being built as far as possible on opposite sides of the streets.

The Edison or low-tension electric lighting and power system employs for its underground service the well-known Edison solid conduit, which having so frequently been described does not require extended notice at this time.

The subway ducts of New York City are almost entirely of wrought iron, and throughout the country at large many thousand feet of this type of conduit are employed. Great quantities of cement-lined pipes and vitrified clay tubes are also employed. Wooden ducts, or pump logs, have also been somewhat extensively used for electrical subway work.

The bulk of the electrical subways of this country are constructed on the "drawing-in" system, except as already noted in the case of the Edison solid ducts.

The conduits or ducts in the drawing-in system, whether of iron, vitrified clay or cement lined, are usually laid in a bed of hydraulic concrete, the number of ducts in a conduit depending on the requirements of each case. One notable example of an extensive drawing-in system during construction is shown in Fig. 2. In this conduit, which was built for the feeders and return wires of an

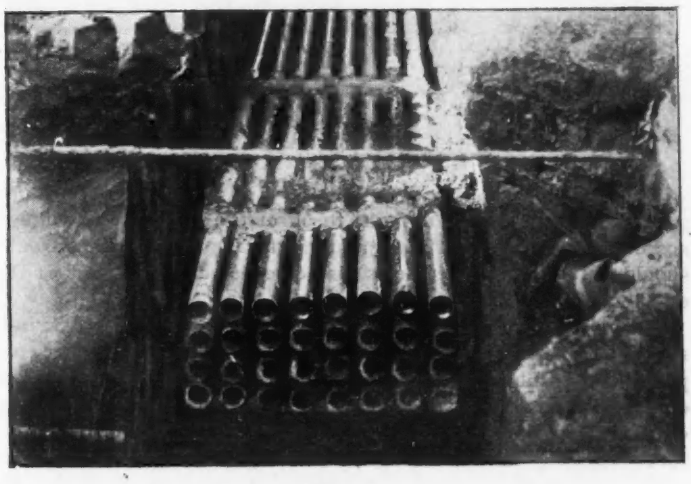


FIG. 2.

electric traction company, there are at one place 220 cement-lined ducts. The illustration also conveys a very good idea of the methods usually followed in the construction of drawing-in types of conduits in large cities. Fig. 5 shows a nearly completed manhole, with some of the apparatus employed in clearing the ducts of any litter, such as pieces of hardened cement, that may have accumulated during construction.

There have been, so far as the writer is aware, very few instances in this country where the cables for electric light and power service have been placed directly in the ground, a plan

FIG. 3.

now quite extensively employed in many places in Europe and Great Britain. In carrying out this latter plan the usual procedure is to construct a trench along the desired route into which the cable, very frequently a concentric cable and heavily armored and juted, is laid, the earth being replaced as before, excepting that a plank is generally placed a few inches above the cable to indicate the presence of the latter to future excavators in the same

vicinity. The writer knows of but one instance in the United States where concentric cables are employed. As pointed out recently in The Electrical World by Mr. Bishop, the probable main reason for this is that the time and expertness required in the making of connections on this form of cable, in addition to its

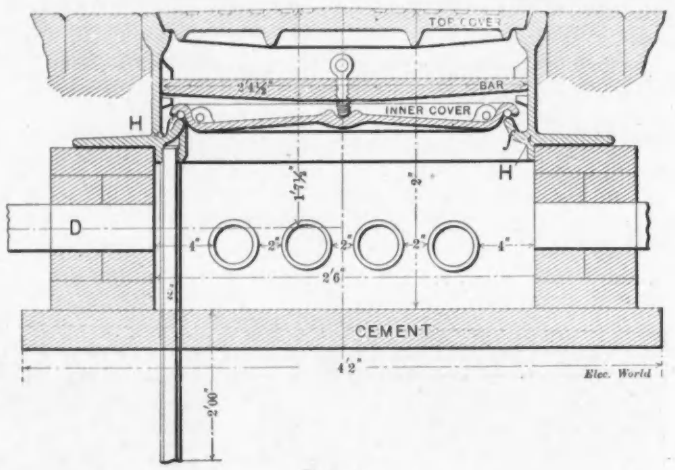


Fig. 4.

greater expense, is not thought to offset the electrical advantages accruing from its use. The greater difficulty in removing trouble should it occur in the cable is also considered a deterrent to the employment of concentric cables here.

The underground cable employed in the high-tension electric light service of this city is mainly of three types, namely, rubber compound cables, fibrous cables and paper cables, all of which are lead covered. The general excellence of the service rendered by these cables is shown by the fact that the average number of radical defects occurring in them is less than one per circuit per annum and from information received from other cities it now appears that this average is fully upheld elsewhere, the exceptions being where inherently imperfect cables or cables improperly treated have been employed. The regular maximum E. M. F. on these cables has not thus far much exceeded 5500 volts continuous current. The average E. M. F. is probably about 3500 volts continuous and 2000 volts alternating current.

Among the more recent innovations in the practical operations of electric light and power circuits in this city is that of the Van Vleck controllable junction box of the Edison Electric Illuminating Com-

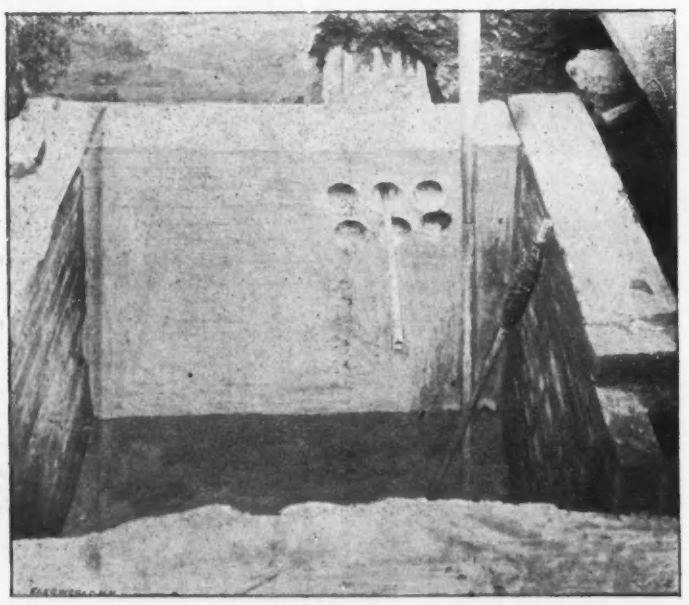


Fig. 5.

pany, by means of which the central station or stations are placed in control of the feeders and branches at any desired point. This box resembles exteriorly the well known Edison junction box, but is somewhat larger. It contains a small Lundell motor of about one sixth horse-power. In the box the motor is placed vertically, its location being indicated in Figs. 7 and 8 by the brushes *b b'*. The motor's shaft carries a pinion which operates gearing *G*, which in turn engages with curved rack *R*. A double-pole knife-blade switch, *H*, is thrown to the right or left by the pull of the spiral spring *K* attached to the rack *R*. In Fig. 7 the connections of the box are arranged for throwing a branch feeder in or out of circuit. In this figure the "branch" is shown as in circuit, but about to be cut out. In Fig. 8 the connections are arranged for dividing or opening a tie feeder; that is, a feeder tied in at two stations. In this figure the feeders are shown as divided, but about to be joined together.

The manner in which these controllable boxes are operated from

Fig. 6.

the central station is practically as follows. In Fig. 7 it is assumed that switch *x* at central station *S* has just been placed in contact with the neutral wire. Thus a current due to 120 volts positive passes through the motor as indicated by the arrows and the motor turns, the effect of which is to move the rack to the right, which results in throwing switches *s s'* off the contacts 1, 2, 3, 4, thereby opening

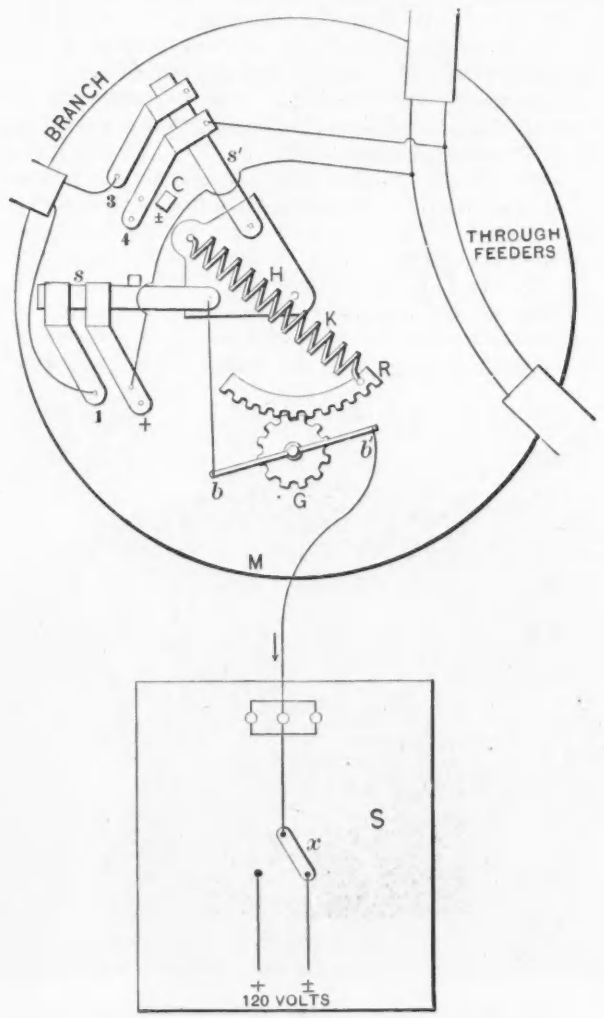


Fig. 7.

the branch feeders at 1 and 3. In moving to the right it is seen the blade *s* makes contact with neutral post *C*. Hence with the switch *x* at *S* on the neutral wire current ceases to flow in the motor and it stops. To return the switch in the controllable box to its former position the switch *x* at the station is turned as shown in Fig. 8, which places 120 volts positive to the motor wire, and a current flows

therein, as indicated by the arrows in opposite direction to those shown in Fig. 7. Consequently the rotation of the motor is reversed and at a given position of the rack the knife switch in the box will be snapped over to the left, thereby closing the tie feeder. In this case when the box switch has passed to the left the blade *s* makes contact with a 120-volts positive feeder, and as before current ceases to flow in the motor circuit. When the lamps at *S* go out it it is known that the switch in the box has operated. The neutral wires in the branches and feeders are united for simplicity in these figures.

Obviously many other switching combinations could be operated by this box. There are now over 12 of these boxes in operation in New York City, the majority of them being in the lower part of the city. The pressure wire of the Edison system is or may be used for the motor circuit.

In all cities where the "drawing-in" or, as it is also called, the "open" subway system is in use, the question of how best to keep gas from adjoining gas pipes out of the conduits and manholes is one that still confronts every one interested.

In New York City, as is generally well known, the counter air pressure is the one adopted. The matter of expense, however, enters very largely into this method and has doubtless been sufficient to prevent its general use in other cities. Hence various methods to give natural egress to the gas which may enter the subways have been resorted to, among those being that of the use of perforated covers for the manholes and the employment of standpipes connected with the manholes, as outlined in Figs. 9 and 10, respectively. In some cities these devices have been fairly successful, in other cities not so much so, and in consequence of these conflicting results satisfactory conclusions as to the efficacy of such methods cannot be reached, the plausible assumption being, in those cases where no explosions have occurred, that the escape of gas into the subways has

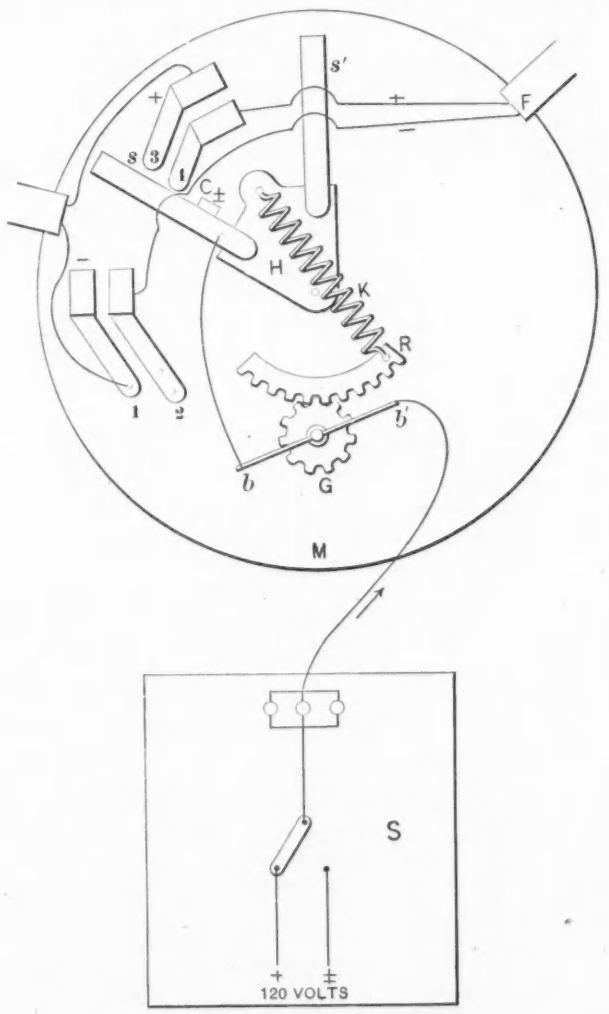


FIG. 8.

been a minimum, this condition being due perhaps to a superior gas pipe construction or to the nature of the surrounding soil.

As to the cause of the explosions when gas has percolated into the subways, it is not always easy to speak definitely. Explosions have been traced to lighted candles in cellars connected by service pipes with the subways; to current escaping from broken trolley wires; to defective cables in the ducts; to sparks from horses' hoofs, etc. But the cause which is so frequently given by theorizers on the subject, namely, lightning, is but rarely if ever the originating cause. In fact, so far as the writer's personal observation extends and from information from other observers in various other cities, it would seem that

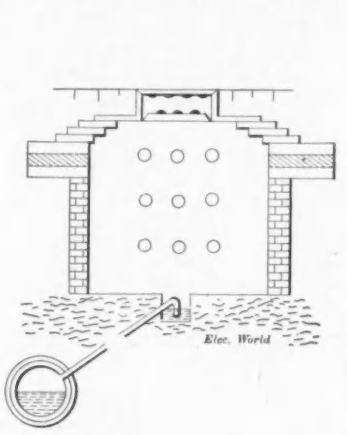


FIG. 9.

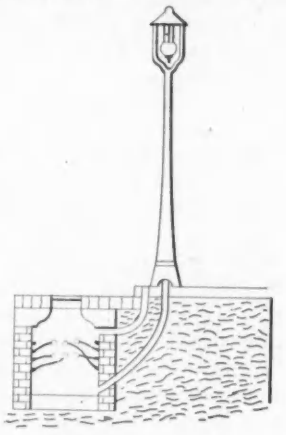


FIG. 10.

explosions occur more frequently in Winter than in Summer, a fact which might be attributed to the frozen condition of the ground, which, by preventing free escape of gas to the surface of the street, leads to a greater accumulation in the subways.

The growth of the underground electrical service in New York City is indicated by the following figures. Thus at the end of the first year of operation, 1889, there were about 200 miles of electric light cables, including the Edison conduits, in the New York subways, where to-day there are about 1400 miles of such cables. The telegraph and telephone underground wires have in the same time increased from about 11,000 miles of circuits to over 40,000 miles. And it is very likely that the foregoing pretty fairly represents the growth of the underground service in the country at large, for while, at the time stated, 1889, New York, Chicago and Philadelphia were perhaps the only cities in this country where electrical subways were in operation to any extent such subways are now to be found in at least 50 American cities and towns.

Some Röntgen-Ray Effects.

It has been found by M. J. Puluj that substances which fluoresce most brightly under the visible cathode rays give off the greatest amount of Röntgen radiation. M. Puluj believes that Röntgen ether waves originate in the bombardment by negatively charged molecules from the cathode, and in the abrupt loss of charge in these. He finds that these Röntgen ether-waves may cause fluorescence of calcium sulphide, but believes that invisible as well as visible radiations emanate from a screen of this substance. M. Puluj states that vacuum tubes of all kinds glow when subjected to the action of Röntgen rays. Messrs. Galitzin and Karnojitzky have been known to detect any sign of polorization of Röntgen rays when crossed. Nicols or crossed ordinary tourmalines were used, but with thin green-brown tourmalines a slight difference was noticed, which, when multiplied by a method deduced by V. Burinsky, based upon the superposition of negative, the difference became considerable. The crossed plates caused the greater absorption of the rays. Thus a distinct evidence has been established, if these experiments be confirmed, that Röntgen-ray vibrations are transverse in their nature and not longitudinal.

Half a Million Dollars for Repairing a Broken Wire.

According to Sir Henry Mance the cost of what was probably the most expensive submarine cable repair on record, was slightly less than half a million dollars; it was on one of the Anglo-American cables.

Cathode Rays.

According to the theory of G. Jaumann, electrical longitudinal rays follow differential equations of the first order, and are generally curved, radiating from the cathode and not toward it. He finds that the cathode rays tend to charge the Crookes tube in such a way that the electrostatic lines of force straighten themselves out.

Alternating-Current Machinery—III.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

SIMPLE-HARMONIC E. M. FS.

17. A simple-harmonic E. M. F. whose graphical representation is a sinusoid, is taken as the representative type of a periodic alternating E. M. F. on account of the simple properties it inherently possesses. The sinusoid, as its name indicates, is a curve of sines. The sine of the angle AOB, Fig. 13, subtended between the fixed line OA, and the movable line OB, of unit length, turning about the point O, may be defined as the value of the orthogonal projection of OB, upon a line coe, which is perpendicular to OA. This projection is ob, and, in the case represented in the figure, the length ob, is just half OB or oc, and consequently the sine of an angle of 30° is 0.5; or, as it is usually expressed, sin 30° = 0.5. The sine of an angle which commences at zero and increases to 90°, increases from 0 to 1. The length of the projection of OB, increasing from o to oc, or unity, which is reached when the arm B reaches C. As the angle AOB, increases from 90° to 180°, the projection oc, diminishes until it becomes o, when 180° is reached, or the position D. Continuing the rotation, the numerical value of the sine increases in the negative direction to the position E, when the sine is $oe = -1$; and, finally, the sine diminishes to o, as the arm turns to the original position OA. The sine of 90° is therefore, + 1; of 180°, 0; of 270° — 1; and of 0°, α 0.

18. The angle, instead of being measured in degrees, is often, for convenience of computation, expressed in *radians*. The radian is an angle such that the arc AB, traversed by the end of the unit radius, is unity, and is, approximately, equal to 57° 17′ 44″. Since the circumference of the circle is 2π times the length of its radius, a complete revolution contains 2π radians. A complete revolution through 360° is divided off in Fig. 14, into unit angles or radians. It will be seen that there are 6.2832, or 2π radians, in 360°, so that an angle of 180° contains π radians, an angle of 90°, $\pi/2$ radians, and generally an angle of $n° = (2\pi/360)\, n$ radians.

19. Fig. 15, represents the relation between an angle and its cosine. The cosine of an angle AOB, contained between a fixed line OA, and a movable line OB, of unit length, may be defined as the orthogonal projection of OB, upon a line doa, parallel to OA. Thus, at the angle of 60°, the projection ob, is half the length of OB, so that the cosine of an angle of 60° or $\frac{\pi}{3}$ is 0.5; or, as it is usually expressed, cos 60° = 0.5; or $\cos \frac{\pi}{3} = 0.5$. As OB, rotates in the direction of the arrow, the cosine ob diminishes until at the position C, the cosine vanishes. Consequently, cos 90° = 0; or, $\cos \frac{\pi}{2} = 0$. Between C and D, $\left(\frac{\pi}{2} \text{ and } \pi\right)$ the cosine is numerically increasing but negatively (0 to — 1) b, being on the negative side of 0. Between D and E, $\left(\pi \text{ and } \frac{3\pi}{2}\right)$ the cosine diminishes from 1 to o; and finally between E and A, $\left(\frac{3\pi}{2} \text{ and } 2\pi\right)$ the cosine increases from o to + 1.

20. It will be evident from an inspection of Figs. 13 and 15, that the sine of an angle reaches its maximum numerical value, + 1 or — 1, when its cosine reaches its minimum numerical value 0, and that the value of the sine of an angle is equal to the value of the cosine of the complement of that angle. Thus the sine of 30° is equal to the cosine of (90° - 30°) = 60°, or is 0.5 If we conceive an arm OB, to rotate with uniform velocity in the vertical plane as shown in Figs. 11 and 12, the orthogonal projection of the extremity of the arm upon a horizontal plane will trace out the sine of the angle contained between it and the vertical stationary line Oo. It will also trace out the cosine of the angle between it and the horizontal stationary line OA. Consequently, the sinusoid is a curve of sines, and is also a curve of cosines, the difference only being in the point which is to be regarded as the origin or starting point of the curve. Thus, in Fig. 16, the heavy line is a sine curve or sinusoid. Thus, it will be seen that the sine of the angle 90° is 1, of 180°, o, of 270°, — 1, and of 360°, o. The cosines of the same series of angles are indicated by the dotted curve. Thus, the cosine of 90° is o; of 180°, — 1, of 270°, o, and of 360°, + 1. The two curves have the same outline, but are displaced 90° in phase. A *cosinusoid*, or curve of cosines, is therefore, a sinusoid displaced forward 90° in phase.

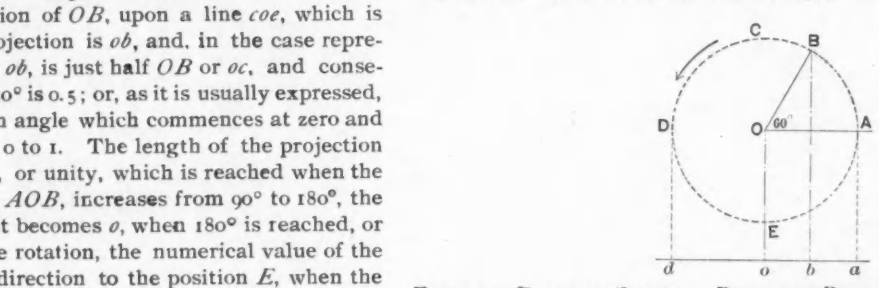


Fig. 15.—Diagram Showing Relation Between an Angle and Its Cosine.

21. The sinusoid of Fig. 16, is traced by first marking off upon the line OO′, of abscissas the angles $o°$ to 360° to a convenient uniform scale. At successive intervals, of say 15°, the sine of each angle is found from a table of sines, and is plotted vertically, as the ordinate above the angle to which it corresponds. For example, the sine of 30° is + 0.5, and is marked off at that elevation at the abscissa of 30°; the sine of 45° is + 0.707, and is marked off at that elevation above the line of abscissas at 45°, and so on. The cosine curve is completed in the same way. The two curves meet at the angle of 45°, and at successive intervals of 180° beyond, the sine of 45° being 0.707 and the cosine being the sine of (90° — 45°) = 45°, or the same.

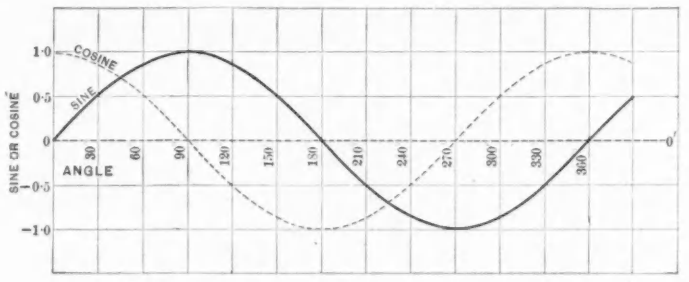


Fig. 16.—Sines and Cosines of Angles.

22. A mechanism capable of producing a simple harmonic motion and consequently of tracing sinusoids when combined with a suitable motion relatively to a sheet of paper is shown in Fig. 17. Here, a disc AOB, is capable of receiving a rotary movement about the axis O. It carries a pin B, free in a block which plays in the slide SS. This slide is carried by a rod RR, moving in the guides GG. A rotation of the disc causes the rod RR, to reciprocate and to perform a simple-harmonic motion. If the disc be supported with the pin at the radius OA, the subsequent displacement of the rod will be proportional to the sine of the angle AOB, through which the disc moves. If the motion of the disc is also communicated, parallel to SS, to a sheet of paper placed underneath the rod RR, a tracing point on the rod will map out a curve of sines or of cosines. If the radius OA, is unity, the sinusoid will be a curve of sines, but if the radius OA, be greater or less than unity, the amplitude of the sinusoid will be greater or less than that of a curve of sines in the same proportion. If the radius $OA = 1$ unit in length, the ordinates of the curve traced out will be always = sin α, where α is the angle contained between the pin and the line OA. If the radius OA, be 2 units in length, the curve traced out will be always 2 sin α, while if the radius OA, be 0.3 unit in length, the curve traced out will be always 0.3 sin α.

23. Fig. 18, represents three sets ofsinusoidal curves. They represent the same simple-harmonic E. M. F. drawn to three different scales. The amplitude of this E. M. F. is 10 volts, and the period 1/20th of a second. Consequently, the uniformly revolving disc whose

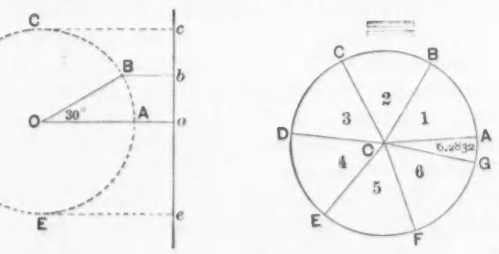


Fig. 13.—Diagram Showing Relation Between an Angle and Its Sine.

Fig. 14.—Diagram Showing the Partition of an Angle of 360° Into 2π Radians.

projection would produce this sinusoid, would have a radius of 10 units, and a velocity of 20 revolutions per second. The angular velocity of the disc would, therefore, be 7200° per second. or $20 \times 2\pi = 40\pi$ radians per second. At any instant of time, t seconds after the starting of the disc from the initial position, the angular distance traveled through would be $40\pi \times t$; so that the ordinate at this time would be $10 \sin (40\pi t)$. For example, at time 0.1 second, the angle would be $40\pi \times 0.1 = 4\pi = 720°$, and the sine of this quantity is zero. The curve would be therefore crossing the line OO', at this time. Each of these three curves represents the simple-harmonic E. M. F. $e = 10 \sin (40\pi t)$ where e is the instantaneous E. M. F. in volts, corresponding to the time t, in seconds after the start. In the first figure, the scale amplitude is greatest, and in the third it is least. In the first figure the scale of time is the least, and in the third greatest. It will be evident from this figure that the shape of a series of waves does not necessarily distinguish a sinusoid; for, in the first curve of the figure the sinusoid is very steep, while in the third curve of the figure it is very flat, and yet both represent the same simple harmonic E. M. F.

24. In general, the angular velocity of the disc which would produce by its projection a given sinusoid, may be expressed by the number of radians executed uniformly per second. This angular velocity may be expressed by the symbol ω. At any instant, t seconds from the start, or from the initial time when the sine is starting positively from its zero value on the line OO', the angular distance, traveled through by the disc will be ωt, and the ordinate on the curve corresponding to this angular distance will be $\sin \omega t$. But this would only be true for a curve of sines whose amplitude was unity. If the amplitude be made e, by suitably changing the radius of the tracing arm, the sinusoid traced will be $e \sin \omega t$.

The same sinusoid will express the cosinusoid $e \cos \omega t$, if the initial time be advanced one quarter of a period; or, this may be expressed without shifting the time as $e \sin \omega t = e \cos\left(\omega t - \frac{\pi}{2}\right)$

25. The sinusoidal E. M. F., represented in Fig. 18, is one whose

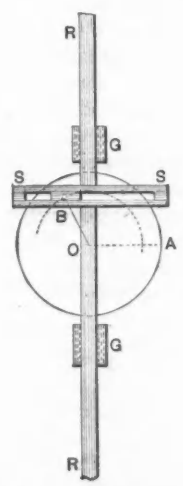


FIG. 17.—MECHANISM FOR RESOLVING A UNIFORM CIRCULAR MOTION INTO TWO SIMPLE-HARMONIC MOTIONS AT RIGHT ANGLES.

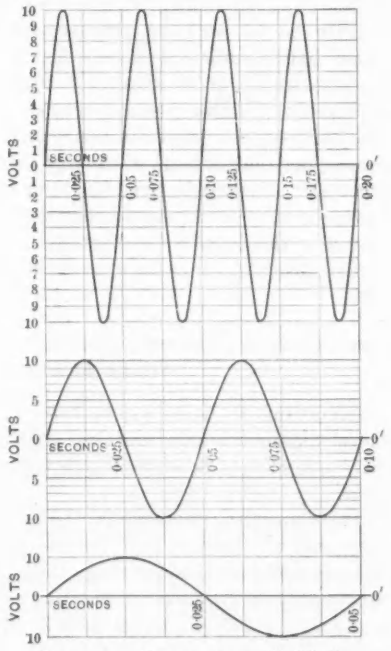


FIG. 18.—SINUSOIDAL E. M. F.

amplitude is 10 volts, and whose cycle is completed in 1/20th of one second, its frequency being 20 ∽. While this maximum value and rate of alternation might equally be shared by an infinite number of periodic alternating E. M. Fs, that E. M. F only can be considered sinusoidal whose magnitude from moment to moment corresponds to the law of sines. Thus at $t = 0.00625$ seconds, or ¼ period from the start $t = 0$, the equivalent angle traversed will be $40\pi \times 0.00625 = 0.25\pi = \pi/4 = 45°$, and the sine of $45° = 0.707$. Consequently, since the amplitude is 10 units, the E. M. F., at this moment, must be + 7.07 volts, and so on for any other instant.

26. When a sinusoidal E. M. F. acts upon a circuit which is not linked with iron, it produces a sinusoidal current, that is to say, a simple-harmonic E. M. F. produces a simple-harmonic current. This is a property which is possessed exclusively by an E. M. F. of this type. With all other types of E. M. F. the current produced, while it may resemble the E. M. F. in form, obeys a different law or differs essentially in outline. Thus, an E. M. F. of the type shown in Fig. 7. will not produce a current of the same sharp-toothed form. This is the secret of the simplicity of the sinusoidal E. M. F., and one of the reasons why it is always selected as a typical alternating E. M. F.

27. Another remarkable property possessed by a sinusoidal E. M. F. or current is that its average rate-of-change is the least for all types or waves. In other words, the sinusoidal wave is the smoothest wave on the average, or has less abruptness of change than any other type. For this reason a sinusoidal current is the most persistent type of current, and the type which tends to be produced or retained. If a non-sinusoidal E. M. F. acts upon a circuit not containing or surrounding iron, the current is also non-sinusoidal, but is a closer approach to the sinusoidal type than the E. M. F. which produces it. As the frequency of the E. M. F. increases, the approach of the current to the simple-harmonic type becomes more marked, and eventually, at an exceedingly high frequency, a non-sinusoidal E. M. F. produces practically a simple-sinusoidal current in the circuit.

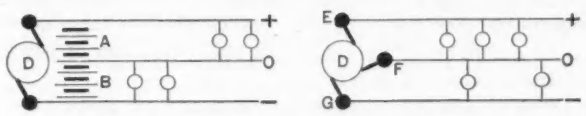
(To be continued.)

Principles of Electrical Distribution.—VII.

BY FRANCIS B. CROCKER.

MODIFICATIONS OF THE THREE-WIRE SYSTEM.

VARIOUS forms of the three-wire system have been used or suggested as substitutes for the ordinary arrangement with two dynamos. One of these modifications, illustrated in Fig. 25, requires only a single dynamo D generating the total pressure for both sides of the system, which is usually about 230 volts. A storage battery $A\ B$ is connected between the two outside wires + and —, the neutral wire o being lead to the middle point of the battery. In cases where it is advantageous to employ a battery to equalize the load on the engines, or for other reasons, this plan is a convenient one, since it only necessitates the running of one dynamo. The potential of the neutral wire o may be varied to make up for differences in load on the two sides of the system by shifting the



FIGS. 25 AND 26.—THREE-WIRE SYSTEMS.

point at which it is connected to the battery. If the difference of potential between the two outside conductors is greater than that of the battery, the latter will be charged, and *vice versa*, the same as in a two-wire system. With a three-wire circuit it is also possible for one part, A, of the battery to be discharging while the other part, B, is charging. This may occur if there are a great many lamps on the + side, and very few lamps on the — side. The function of the battery is to act as an equalizer, taking or giving current, as required, and keeping the neutral wire approximately midway in potential with respect to the outer conductors.

Fig. 26 indicates another three-wire arrangement that can be operated with only one generator D, the neutral wire being connected to a third brush F placed half way between the main brushes E and G, to which the outside wires + and — are respectively attached. With most types of dynamo the brush F would spark excessively because it short circuits the armature coils when they are generating the maximum E. M. F. There are several ways to avoid this difficulty, one of which consists in employing a four-pole dynamo, Fig. 27, having two adjacent north poles, the other two being south poles. The machine thus becomes in effect a bipolar dynamo with each pole divided, the armature coils short-circuited by the brush F being in the space between the two halves S and S of the south pole, where they generate little or no E. M. F. A dynamo to be used in this way requires a field magnet ring of sufficient cross-section between the N and S poles (*i. e.*, at the top and bottom in Fig. 27) to carry the total magnetic flux of one field core. In an ordinary multipolar machine with alternate N and S poles this ring need only have one half the sectional area. Since practically no flux passes through the two sides of the ring they might be greatly reduced in size, but this is limited by considerations of strength and appearance. The radial depth of the armature core must also be sufficient for the total flux of one field core. The extra quantity and less favorable disposition of material in the generator is not a very serious matter

however, and this plan of operating a three-wire system would often be a very practical and convenient one for small plants.

In the three-wire system represented in Fig. 28 the neutral wire *O* is connected to an auxiliary machine *H* which supplies a potential one half as great as that of the main dynamo *D*. The machine *H* acts as a generator when the — side requires more current than the + side, but it runs as a motor when the current on the + side is greater. Hence it should be belted to or directly coupled with the dynamo *D* in order to save its power when acting as a motor. The

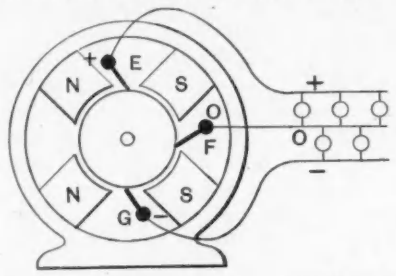


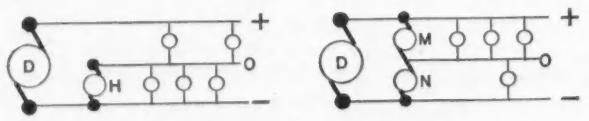
Fig. 27.—Three-Wire System with One Dynamo.

machine *H*, being intended to furnish only the difference between the currents on the two sides of the system, may have only 5 or 10 per cent. of the capacity of the dynamo *D*. This is sufficient as long as the sides are fairly well balanced, but is entirely inadequate if the difference becomes great, which may easily occur by accident. The ordinary three-wire arrangement, or that shown in Fig. 26, has the advantage of being able to operate, if necessary, with a full load on one side and none on the other, in case of an open circuit on one of the outside wires, due to the blowing of a fuse or to some other cause.

The same reasoning applies to the storage battery in Fig. 25, which may be designed to have a capacity equal to the full load or only a fraction of it.

In Fig. 29 the two auxiliary machines *M* and *N* are mechanically coupled together and each generates one half as much pressure as the main dynamo *D*. These machines serve to equalize the pressure and load, the one on the more lightly loaded side running as a motor and driving the other as dynamo. Hence they are capable of operating with a difference in energy on the two sides of the circuit, equal to their combined capacity.

This combination involves three machines in place of the two dynamos required in the ordinary three-wire system, nevertheless it is very commonly and successfully used, being in many cases decidedly preferable to the latter. The two machines *M* and *N* are entirely self-acting, driving each other mechanically and maintaining equal voltages, with very little attention or likelihood of trouble. They are much more easily operated than a second dynamo, and the friction and other losses involved are also considerably less. If both armature windings are upon the same core, armature reaction is neutralized and the tendency to sparkling greatly reduced. A still more important advantage is the fact that the double machine *M N*

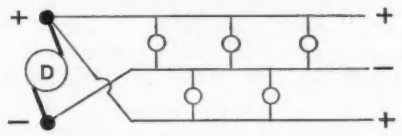


Figs. 28 and 29.—Three-Wire System.

can be placed at any desired distance from the generating plant and connected to it by two feeders, three wires being required only for the local distribution. It is also possible to run a "booster" or small auxiliary series-dynamo by means of the equalizing machines *M* and *N*, in order to raise the pressure of the circuit and make up for drop on the conductors. This and several other applications of equalizing machines are described in The Electrical World, May 23, 1896, p. 596.

The storage battery represented in Fig. 25 can also be placed at a distance from the generator in order to secure a similar saving in the number of conductors. It possesses the additional advantage over the equalizing machines that it enables the current on the feeders to be made more uniform, the battery being charged during periods of light load and discharged when the demands for current are great. This permits feeders of smaller size to be used, and also reduces the variations in load on the generating plant, so that it operates more efficiently and can be designed for less capacity than the maximum load.

Conversion from Three to Two-Wire Circuit.—A three-wire system of conductors can readily be connected so that it may be used as an ordinary two-wire circuit. For this purpose the two outside wires are connected to one terminal and the middle wire to the other terminal of the generator, as represented in Fig. 30. The lamps are fed between the middle conductor and either of the others, but the direction of current is reversed in all of those that are on one side of the system. This makes no difference in the operation of incandescent lamps, but would require the connections of arc lamps to be reversed, the same being true of storage batteries, electroplating cells or other electrochemical apparatus that may be on that side of the system. Motors operated on one side of the circuit would not be affected since the direction of rotation is not changed by reversing the current in both armature and field coils. But a motor or other



Fig, 30.—Conversion of Two-Wire to Three-Wire System.

device connected across the outside wires, which is the usual arrangement for the former, would receive no current because these wires are of practically the same potential when used as a two-wire circuit.

The drop on the conductors is greatly increased by conversion to the two-wire arrangement. In a perfectly balanced three-wire system there is practically no current or drop on the middle wire, but when used as a two-wire circuit the current and drop on this conductor is twice that in either of the others, consequently the total drop is three times as great as before. There is also danger of blowing the fuses on the middle wire, or overheating it, unless it is specially designed to be used in this way.

There are two cases in which the conversion from the three to the two-wire system is commonly practiced. First, a central station or isolated plant, which is operated on the three-wire plan, when heavily loaded, and on the two-wire plan for light loads, one dynamo being sufficient in the latter case, and the drop on the conductors being quite small. Second, an isolated plant, which is supplied by its own generator most of the time, but is connected to the three-wire "street circuit" (*i. e.*, central station conductors) during certain portions of the day or night, or in case its machinery is disabled. On account of the latter contingency the name "breakdown switch" is applied to the device, which connects the inside wiring to the outside conductors. This switch is so made that it simultaneously opens the connections with the local generator.

(*To be Continued.*)

The Toronto Meeting of the British Association for the Advancement of Science.

According to a despatch from Toronto active preparations are being made for the meeting of the British Association for the Advancement of Science, which will be held in that city in August next.

The Canadian Parliament, the Legislature of the Province of Ontario and the City of Toronto have voted grants sufficient to defray the expenses of the meeting. The meetings will be held at the University of Toronto, and a civic committee has been at work for some time making preparations for the event. The Canadian railways, it is stated, will grant special rates to members of the association who wish to journey about the country, at the expiration of the meeting. It is thought that more than 1000 scientists will be in attendance, including many members of the American Association for the Advancement of Science, which body will meet in Detroit a week prior to the meeting of the British Association in Toronto. The local committee in Toronto, it is reported, has invited the attendance of nearly 50 of the most famous men of science in France, Germany and other Continental countries.

The last meeting of the British Association in America was held in Montreal, in 1884, when Lord Rayleigh presided. This year's meeting will be held under the presidency of Sir John Evans, treasurer of the Royal Society, and a distinguished archæologist.

Electric Railways in Germany.

According to recent statistics the length of all the electric railways in Germany is less than in the City of Philadelphia.

The Berliner Patent Situation.

For the benefit of our readers who take an interest in the suit of the United States *vs.* the American Bell Telephone Company for the cancellation of the Berliner patent, we print below the more important portions of the Patent Office records, which bear directly upon the invention of the microphone.

Previous to the fundamental patent granted on March 7, 1876, to Alexander Graham Bell, disclosing the method of transmitting and receiving speech by means of electrical undulations similar in form to sound-waves, the transmission of musical sounds had been successfully accomplished by Phillip Reis. Reis used a transmitter similar to the Berliner transmitter, including metallic electrodes. The instrument was adjusted to "make and break" the electrical circuit at each vibration. Thus the pitch and loudness of the transmitted tone could be reproduced, but as the electrical undulations were not similar in form to the sound-waves, the characteristics of the tone transmitted, which are essential for articulate speech, were not present. This was the state of the art when Bell's patent issued on March 7, 1876.

Bell's fifth claim, which was upheld by the Supreme Court, reads:

"The method of, and apparatus for, transmitting vocal or other sounds telegraphically, as herein described, by causing electrical undulations similar in form to the vibrations of the air accompanying the said vocal or other sounds, substantially as set forth."

In reference to the microphone or battery transmitter, Bell said in his application:

"Electrical undulations may also be caused by alternately increasing or diminishing the resistance of the circuit, or by alternately increasing and diminishing the power of the battery. . . . The external resistance may also be varied. For instance, let mercury or some other liquid form part of a voltaic circuit, then the more deeply the conducting wire is immersed in the mercury, or other liquid, the less resistance does the liquid offer to the passage of the current. Hence the vibration of the conducting wire in the mercury or other liquid included in the circuit occasions undulations in the current."

The fourth claim of Bell, referring to this battery transmitter and claiming its method of operation, was also upheld by the Supreme Court.

Claim 4. "The method of producing undulations in a continuous voltaic circuit by gradually increasing and diminishing the resistance of the circuit, or by gradually increasing and diminishing the power of the battery, as set forth."

It appears from the records of the Berliner case that Bell successfully operated such a battery transmitter on March 10, 1876, and exhibited and operated a similar transmitter at the Centennial of the same year. Also that on May 10, 1876, Bell described the construction and operation of his liquid transmitter in a paper read before the American Academy of Arts and Sciences.

Nearly one year later, *i. e.*, on April 14, 1877, Emile Berliner filed a caveat at the Patent Office, describing an instrument differing from Bell's in the substitution of a hard metallic surface in place of the liquid surface which Bell employed, and claiming the operation of such an instrument both as a transmitter and as a receiver for the transmission of sound of any kind.

As this caveat forms one of the strongest grounds for the American Bell Telephone Company's contention, we print it in full.

CAVEAT SPECIFICATION.

Part I. The following is a description of my newly invented apparatus for transmitting sound of any kind by means of a wire or any other conductor of electricity, to any distance.

It is a fact and a scientific principle that objects near each other which are charged with electricity of the same polarity repel each other. It is also a fact that if at a point of contact between two ends of a galvanic current, the pressure between both sides of the contact becomes weakened, the current passing becomes less intense, as, for instance, if an operator on a Morse instrument does not press down the key with a certain firmness, the sounder at the receiving instrument does work much weaker than if the full pressure of the hand would have been used. Based on these two facts I have constructed a simple apparatus for transmitting sound along a line of a galvanic current in the following manner:

Part II. In the drawing accompanying this caveat *B*, is a metal plate well fastened to the wooden box or frame *A*, but able to vibrate if sound is uttered against it, or in the neighborhood of said plate. Against the plate, and touching it, is the metal ball *C*, which rests on the bar or stand *F*, and presses against the plate, which pressure, however, can be regulated by the thumb-screw *D*, attached to the ball. By making the plate vibrate, the pressure at the point of contact *a*, becomes weaker or stronger as often as vibrations occur and according to it from which side of the plate the sound comes.

Part III. If a current of electricity passes through the plate and the point of contact, or *vice versa*, a repulsive movement will take place between the plate and the ball because both are charged with the same kind of electricity. This force of repulsion may be weakened or strengthened by varying the strength of the current.

Part IV. By placing now, as in the drawing is shown, one such instrument in the station Fig. 1 and another instrument in the station Fig. 2, both situated on the same voltaic current (as shown by the wire connections following the arrows), sound uttered against the plate of the instrument Fig. 1 will be reproduced by the plate of the instrument Fig. 2; for as the vibrations of the transmitter Fig. 1 caused by the sound, will alternately weaken and strengthen the current as many times as the vibrations occur, so will also the force of repulsion at the point in the receiver be alternately weakened and strengthened as many times accordingly, and will therefore cause the plate to vibrate at the same rate and measure. The latter vibrations being communicated to the surrounding air, the same kind of sound as uttered against the transmitter Fig. 1 will be reproduced at receiver Fig. 2, or in as many other receiving instruments as are situated within the same voltaic circuit.

Part V. It is not material that the plate should be of metal; same can be of any material able to vibrate, if only at the point of contact suitable arrangement is made so that the current passes through that point. The plate may be of any shape or size, and may be substituted by a wire. The ball, too, may be substituted by any other metallic point, surface, wire, etc. There may be more than one point of contact becoming affected by the same vibrations, and either side or both may vibrate, although it is preferable that only one side should vibrate.

Part VI. If the uttered sound is so strong that its vibrations will cause a breaking of the current at the point or points of contact in the transmitter, then the result at the receiving instruments will be a tone much louder, but not as distinct in regard to articulation.

Part VII. What I claim to have invented is

1. An instrument situated within an electric circuit having two or more ends of the current brought in contact with each other, which points of contact can be loosened or tightened by vibrating one or both sides of each contact, thus diminishing and increasing the amount of electricity passing through the contacts as many times as vibrations occur.

2. An instrument like this one described, situated within a voltaic circuit, and having two or more ends brought in contact with each other at which point or points of contact exists a force of repulsion, caused by equal polarity which force can be increased or decreased by increasing or decreasing the strength of the current passing through the points of contact.

3. An apparatus consisting of a metal plate able to vibrate in contact with a metal ball, each of which within the same voltaic or galvanic circuit, so that if, by vibrating the plate, the pressure at the point of contact gets loosened or tightened, the amount of electricity passing in the current is diminished or increased, as described.

4. Same instrument to be used as a transmitter of sound-waves by uttering sound against or in the neighborhood of the said plate or its mechanical equivalent, thus vibrating the plate and diminishing the amount of electricity passing as many times and as much as the vibrations will loosen the pressure of contact, as described.

5. Such a similar apparatus to be used as a receiver or reproducer of sound-waves by allowing an electric current consisting of waves which are produced as described in Claim No 4, to pass through the point of contact, thus increasing or decreasing the force of repulsion already existing between the plate and the ball at the contact when a current is passing. The plate therefore being thrown into vibrations as many times and with an intensity in accordance with the number of waves and their intensity, the air surrounding the receiving plates will also be vibrated and reproduce a sound similar to the one uttered in the transmitting instrument, as described.

6. A combination of two or more such instruments situated on the same voltaic circuit or current of electricity, so that if one plate is vibrated all the others will vibrate at the same rate and measure, as described.

7. A system of telephony for the purpose of transmitting sounds to any distance by means of a wire or other conductor of electricity, as described.

EMILE BERLINER.

Witnesses: J. S. WIMSATT,
O. KIMMELL.
(Sworn to April 13, 1877.
Filed April 14, 1877.)

This caveat undoubtedly expresses a mechanical conception by which the undulating currents which Bell had shown to be necessary for the transmission of speech, could be produced. But was Berliner successful in his conception? His testimony shows that up to the date of filing his application on June 4, 1877, he had met with but little success in the transmission of speech, although he had had greater success in the transmission of musical sounds. On May 9, 1877, Berliner filed another caveat in which he described his double pin make-and-break transmitter, and which, as stated in the application of June 4, he employed for the transmission of speech.

Below we print the application of June 4, 1877, followed by the patent as finally issued after its various erasures and amendments. The omissions refer only to unimportant features of the patent, including the mechanical and chemical receiving devices. The italics in all cases are our own.

It will be noticed that Berliner states in the June 4 application that his apparatus of the April 14 caveat, *i. e.*, the constant-contact transmitter, will reproduce musical tones, but that it is not adapted for the transmission of speech. The apparatus of the May 9 caveat, however, *i. e.*, the double-pin make-and-break transmitter, Berliner describes and claims for the transmission of speech.

ORIGINAL APPLICATION, FILED JUNE 4, 1877.

This invention relates to certain improvements in producing, transmitting and recording sound waves or vibrations by the agency of electricity.

Voltaic or galvanic currents as ordinarily employed produce no particular mechanical effects, and hitherto in order to render this kind of electricity

practically useful for telegraphic purposes, the creation by it of magnetic forces or the induction of secondary currents has been necessary for the production of the proper mechanical results.

The object of my invention is to produce by a common galvanic current marked mechanical effects that will be distinctly demonstrated to the observer, either in the form of sound or in visible character, as more fully hereinafter specified. To this end my invention consists:

First. In an instrument for transmitting and reproducing sound waves by the agency of electricity consisting of a metallic diaphragm or other vibratory medium, connected to or forming part of one pole of an electric circuit, arranged in contact with the opposite pole thereof, and capable of being put in vibration by the action of the electric current, as more fully hereinafter set forth.

Second. In an instrument for transmitting and reproducing sound waves by the agency of electricity, consisting of two vibratory plates of metal or other suitable material, one attached to or forming part of each pole of the battery, arranged in contact with each other, and capable of being put in vibration bythe action of the electric current, as more fully hereinafter specified.

Third. In combination with said vibratory diaphragm of a pin arranged out of contact with the same but within its field of vibration and in the same electrical circuit, for producing and transmitting special sound-waves as more fully hereinafter set forth. * * * *

Sixth. In the combination with the diaphragm and pin, and in the same electric circuit therewith of an induction coil, the secondary of which is broken at short distances so as to interrupt the passage of the current for the production of sound waves as more fully hereinafter explained.

Seventh. In the combination with the secondary coil of said induction coil of a strip of prepared paper or other material which may be carried between the two poles of said secondary coil in such manner as to record the electrical impulse passing through the same, as more fully hereinafter described * * * *

The operation of my invention is as follows: If a circuit of electricity of ordinary strength is made to pass through the plate and the screw across the point of contact x, as is shown by the arrows along the current, the whole amount of electricity will not be able to pass quietly over the narrow point of contact and the consequence will be that it will accumulate to a state of tension on both sides of the contact and the passing over of the current at the point of contact will be so violent as to shake the plate off from the screw. The shock will be particularly strong at the setting in and at a sudden ceasing of the current, when a cracking sound will be heard from the plate. But a weakening of said current alone can also be observed by making for example a connection within the same current by a wire and a blade of a knife. When scraping the wire end over the blade of the knife, this scraping is distinctly audible on the plate. Here the current is never entirely interrupted, yet the minute elevation and cavities on the blade caused by the structure of the steel and which again cause minute alterations in the intensity of the current are sufficient to shake or vibrate the plate with varying intensity, thus rendering again the same peculiar, scraping noise.

If now the plate of one instrument, as in Fig. 3, is vibrated by sound waves (which happens whenever any kind of sound is uttered or produced by musical instruments in its neighborhood) every wave or vibration that strikes the plate will cause a weakening of the point of contact x, or also if the sound is sufficiently strong, a break of the electric current at that point.

It is evident that changes thus occurring at the plate of one instrument will be noticed at the plate of the other, or in any such instruments that are situated within the same electrical connection, and as often as one plate is caused to vibrate, just so often will the others vibrate, caused by the break or the weakening of the electrical current. The same kind of sound therefore which affects the plate of the first instrument will be reproduced by the plates of the others.

[*These simple instruments will reproduce any musical sound uttered in the neighborhood of one of them; but for the reproduction of special sound, such as speech, they are not adapted for the following reasons:* In accepting the graphical name of wave for a vibration we must consider the same to have two dimensions, namely, length and height, yet they differ in shape and their highest point is not always situated in the centre of their length. Such is the case with sound waves of various kinds of sounds. In a pure musical tone the shape of the wave is entirely regular, like in section 1, but in every other sound this is not the case. *It is therefore evident that the apparatus described thus far cannot but transmit a pure musical sound, because it transmits only the number of vibrations per second which is equal to the lengths of the waves, but nothing of the nature of each wave and the shape of their curves is recorded. This I accomplish, however, by situating within the vibrating field of the plate A a second screw, E.* In Fig. 6 the dotted line indicates the vibrating field of the plate B, the screw in contact with the plate and E the second screw. It will now happen in special sounds (meaning the nature of every sound besides its certain musical pitch) that the plate will not always strike the screw E, in the middle of the duration of one wave or vibration, and taking for instance the duration of one wave to be one minute, the plate in special sound will sometimes strike the screw E, sometimes after 20 or 25 seconds after its beginning. This now is exactly recorded by the secondary screw E, which also makes an electric connection whenever the plate A touches it, and at the receiving apparatus these special sounds will therefore be noticed. I have thus succeeded in reproducing a great many special sounds, such as the vowels and others.]

[*The principle of reproducing special sounds by break and make of contact rests mainly in the use of this secondary contact-screw.*] * * * *

What I claim and desire to secure by Letters Patent is:

1. An instrument for transmitting and reproducing sound waves by the agency of electricity, consisting of a metallic diaphragm or other vibratory medium connected to or forming part of one pole of an electric circuit and arranged in contact with the opposite pole thereof, and capable of being put in vibration by the action of the electric current, substantially as set forth.

2. An instrument for transmitting and reproducing sound waves by the agency of electricity, consisting of two vibratory plates of metal or other suitable material, one attached to or forming part of each pole of the battery, arranged in contact with each other and capable of being put in vibration by the action of the electric current, substantially as set forth.

3. The combination in one circuit of two or more vibratory diaphragms and contact pins, adapted to operate similarly for the production and transmission of sound waves when one diaphragm is caused to vibrate by means of any sound, substantially as set forth.

4. In combination with the metallic diaphragm and its contact pin, of a secondary pin out of contact with said diaphragm but within its vibratory field, and the same electric circuit, the whole adapted to operate as set forth for transmitting special sounds. * * * *

SPECIFICATION FORMING PART OF LETTERS PATENT NO. 463,569
DATED NOVEMBER, 17, 1891. (*Application file, June 4, 1877.*)

To all whom it may concern:

Be it known that I, EMILE BERLINER, of Washington, in the District of Columbia, have invented a new and useful Improvement in Combined Telegraph and Telephone, of which the following is a specification:

My invention consists in a new and useful improvement in transmitters for

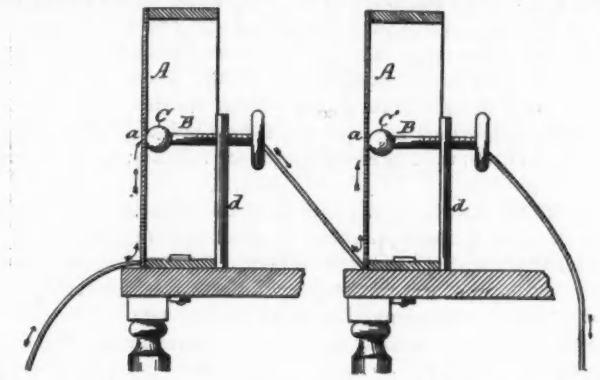


FIG. 1 FIG. 2.

electrically transmitting sound of any kind, of which the following is a specification:

It is a fact that if at a point of contact between two conductors forming part of an electric circuit and carrying an electric current the pressure between both sides of the contact becomes weakened, the current passing becomes less intense—as, for instance, if an operator on a Morse instrument does not press down the key with a certain firmness the sounder at the receiving-instrument works much weaker than if the full pressure of the hand had been used. Based on this fact I have constructed a simple apparatus for transmitting sound along a line of an electric crurent in the following manner:

In Fig. 1 and 2 of the drawings, A is a metal plate well fastened to the wooden box or frame, but able to vibrate if sound is uttered against it or in the neighborhood of said plate. Against the plate and touching it is the metal ball C, terminating the screw-threaded rod B, which is supported by the bar or stand d. The pressure of the ball C against the plate A can be regulated by

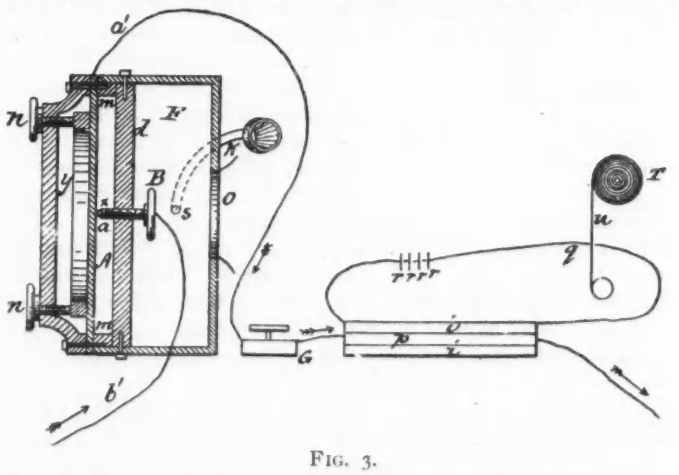


FIG. 3.

turning the rod B. The said ball and plate are included in circuit with an electric battery, so that they form electrodes, the current passing from one of them to the other By making the plate vibrate the pressure at the point of contact a becomes weaker or stronger as often as vibrations occur, and the strength of the current is thereby varied accordingly, as already described. By placing now, as is shown in the drawings, one such instrument in the station Fig. 1, and another instrument capable of acting as a telephonic receiver in the station Fig. 2, both situated on the same electric circuit in which a current is passing (as shown by the wire connections following the arrows), sound uttered against the plate of the instrument Fig. 1 will be reproduced by the plate of the instrument Fig. 2, for as the vibrations of the transmitter, Fig. 1, caused by the sound will alternately weaken and strengthen the current as many times as vibrations occur, the diaphragm of the receiver will be caused by these electrical variations to vibrate at the same rate and measure. The latter vibrations being communicated to the surrounding air, the same kind of sound as uttered against the transmitter Fig. 1, will be reproduced at the receiver Fig. 2, or in as many other receiving instruments as are situated within the same electric circuit.

It is not essential that the plate should be of metal. It can be of any material able to vibrate, if only at the point of contact suitable arrangement is made so that the current passes through that point. The plate may be of any shape or size, or other suitable vibratory media may be used—a wire, for example. Any other metallic point, surface, wire, etc., may be substituted for the ball. There may be more than one point of contact to be affected by the same vibra.

tions. Both of the electrodes may vibrate, although it is preferable that only one should. If the uttered sound is so strong that its vibrations will cause a breaking of the current at the point of contact in the transmitter, then the result at the receiving-instrument will be a tone much louder, but not as distinct in regard to articulation.

I have also embodied my invention in and used it in connection with some other forms of apparatus. * * * *

In the drawings, the letter *A* represents a diaphragm or plate of thin metal, of limited conductive capacity, such as iron, steel, German silver, platinum, secured in the frame *m m* in the box *F* in any convenient manner.

The letter *y*, represents a ring resting against one side of said diaphragm and capable of being made to bear upon the same with more or less force by means of set-screws *n*, in order that the tension of the diaphragm may be regulated.

The letter *B* represents a screw or pin of metal, pointed at one end and mounted in a cross-piece *d* in such position that the point will be in contact with the diaphragm *A*. The diaphragm *A* is connected with one pole of a battery by means of a wire *a'*, and the pin or screw *B* with the other pole by means of a wire *b'*.

The box *F* of Fig. 3 is provided with a tube *K*, to which the ear of the operator may be applied, in order to hear the sounds produced by the vibratory diaphragm when the instrument is employed as a receiver, and a tube *O*, through which he can speak when employing the instrument as a transmitter, so that the operator is not in need of moving the instrument or moving his head while carrying on a conversation.

Instead of employing a single vibratory plate as shown in Figs. 1, 2, 3, 4 and 5, in each instrument, two such plates may be employed, as illustrated in Fig. 8, said diaphragms being connected to the respective poles and in contact with each other at their edges, as shown in Fig. 8.

The diaphragm of my improved receiver or the diaphragm of any magneto-receiver (such as those described by Alexander Graham Bell in his Patent No. 174,465 of March 7, 1876, and in his Patent No. 186,787 of Jan. 30, 1877), will receive a particularly strong shock at the setting in and sudden cessation of the current, when a ticking sound will be heard from the plate; but a weakening of the current alone can also be observed most distinctly and accurately by making, for example, a connection within the same circuit by a wire and the blade of a knife *k*, Fig. 4. When scraping the wire end over the blade of th knife, this scraping is distinctly audible on the plate. Here the current is never entirely interrupted, yet the minute elevations and cavities on the blade caused by the structure of the steel and which again cause minute alterations in the intensity of the current, are sufficient to shake or vibrate the plate with varying intensity, thus rendering again the same peculiar scraping noise. If, now, the plate of one instrument, as in Figs. 1 or 5, is vibrated by sound-waves (which happens whenever any kind of sound is uttered or is produced by musical instruments in its neighborhood), every wave or vibration that strikes the plate produces between the two sides of the contact a variation of pressure, which causes a variation of resistance at that point, and therefore a variation in the strength of the passing current, and if the sound is sufficiently strong it will break the circuit at said point of contact, the variations in the current thus produced causing similar vibrations in the plate of the receiving instrument. The essential part of the apparatus is the point of contact which must offer a resistance to the current.

It is not necessary in the transmitting apparatus that the plate should be of conducting material, for any substance capable of vibration will answer if only at the point of contact provision is made for the current to pass. It is sometimes convenient to use a vibrating plate in the form of a reflector, as shown in Fig. 6, for concentrating the sound, or the diaphragm may be provided with a number of apertures to disperse the sound, as shown in Fig. 7. These apertures prove advantageous with strong sounds, particularly the hissing sounds, as while the sound-waves are rushing toward the diaphragm, those touching the plate are repelled and partially destroy the following waves, just as sea-waves when forced against a cliff will be thrown back, destroying those directly behind. The holes permit most of the waves to pass to the other side of the plate, making the vibration of the plate more perfect and even. * * * *

I do not claim that I am the first inventor of the art of transmitting vocal and other sounds telegraphically by causing electrical undulations similar in form to the sound-waves accompanying said sounds. Neither do I claim that I am the first who caused such electrical undulations by varying the resistance of an electric circuit in which a current was passing.

I do not herein claim the novel form of vibratory-plate receiver which I have described, because that is a subject of claim in another application.

I claim:

1. The method of producing in a circuit electrical undulations similar in form to sound-waves, by causing the sound-waves to vary the pressure between electrodes in constant contact so as to strengthen and weaken the contact, and thereby increase and diminish the resistance of the circuit, substantially as described.

2. An electric speaking-telephone transmitter operated by sound-waves and consisting of a plate sensitive to said sound-waves, electrodes in constant contact with each other and forming part of a circuit which includes a battery or other source of electric energy, and adapted to increase and decrease the resistance of the electric circuit by the variation in pressure between them caused by the vibrational movement of said sensitive plate.

In testimony that I claim the foregoing I have hereunto set my hand in the presence of the subscribing witnesses. * * * *

J. A. RUTHERFORD, JAMES L. NORRIS. } *Witnesses.* EMILE BERLINER.

It will be seen that claims 1 and 2 of the application of June 4 are for the instrument acting as a receiver; claim 2 is for the combination of the transmitter (producer) and receiver, thus distinguishing from the apparatus of Phillip Reis; while claim 4 alone refers to the transmission of "special sounds such as speech," and claims the secondary pin instrument, *i. e.*, the make-and-break transmitter, for the accomplishment of this purpose. The other claims are for unimportant details.

On June 27 and July 14, 1877, Berliner filed amendments relating principally to his make-and-break transmitter.

About this time however, July 9, 1877, the Philadelphia *Press* described the constant contact carbon transmitter of Edison and stated that by the use of carbon in constant contact "fine articulation of the voice is obtained." A paper describing the construction and operation of the carbon telephone was read by Mr. Preece before the British Association in August, 1877, and was followed by other publications.

On Aug. 8, 1877, Berliner struck out of his specification all matter referring to the secondary contact screw, and one month later he filed a substitute sheet of drawings, omitting the secondary screw contact and inserted a drawing of a constant-contact carbon transmitter. This carbon transmitter was however stricken out later, on interference proceedings with Edison.

On Oct. 27, 1877, Berliner struck out his entire application, including the claims, and substituted a new one. The brackets which will be found including certain paragraphs in the June 4 application, printed above, indicate the principal matter left out in the new application. But as yet Berliner had not abandoned the idea of "make-and-break." Thus he states:

"My invention consists :

"First. In an instrument for transmitting and reproducing sound waves by voltaic agency, consisting of one or more diaphragms forming the poles of a galvanic circuit in contact with each other and adopted to vibrate freely when the contact is *either modified or broken*, according to the strength of the vibrations, substantially as hereinafter specified."

The first claim reads :

"An instrument consisting of the two poles of an electric circuit in contact one with the other, either or both of said poles forming a vibratory diaphragm or medium to be used for transmitting and reproducing sound vibrations *by either altering or disconnecting said contact at each vibration.*"

However, in 1878, the Bell Telephone Company secured possession of the Berliner application, and after again striking out the entire application and drawings, substituted new ones on Sept. 1, 1880, which unquestionably described the constant-contact transmitter.

This left the application in a form practically identical with the patent as it issued 11 years later, and in the form, with unimportant omissions, as printed above.

Berliner's assignment of this invention was as follows:

"I do hereby sell, assign, and set over to said The American Bell Telephone Company, the said application, the inventions therein described, *or intended to be described*, and all letters patent that may be granted therefor."

In this connection it is interesting to see how Berliner described his invention of the June 4 application on Dec. 8 of the same year, which was subsequent to various publications of the Edison constant-contact transmitter, and subsequent to the various amendments which Berliner had made in his application on abandoning the make-and-break transmitter. On Dec. 8, 1877, Berliner filed an application for certain improvements in electrical telephony, and received a patent grant for the same on Jan. 15, 1878, No. 199,141. In this patent Berliner states that he has found since June 4 that with the constant-contact transmitter "the effect on the receiving instrument is not very strong, and particularly at long distances the effect is but feeble and requires some attention to be audible."

The reissue of this patent, No. 9499, Dec. 14, 1880, fails to state that Berliner had made this discovery since June 4, 1877. There are many other interesting differences between the descriptions of the June 4 application made by Emile Berliner, of Washington, D. C., and of Boston, Mass., which are brought out in the parallel columns printed below, of the original and reissue patents.

ORIGINAL BERLINER PATENT.
No. 199,141. Jan. 15. 1878.
Filed Dec. 8, 1877.

Be it known, that I, Emile Berliner, of Washington, D. C., have invented certain new and useful improvements in electrical telephony, of which the following is a specification.

These improvements shall be applied in such instances where it is necessary to increase the effect of an electric current on a telephone receiver, by connecting the main line on which the transmitter is situated with a local battery circuit on which the receiver is situated. They also refer to a certain multiplication of a former device of the telephone itself, as herein more fully specified.

In an application for Letters Patent made by me June 4, 1877, I have

RE-ISSUE BERLINER PATENT.
No. 9,499. Dec 14, 1880.
Filed Oct. 23, 1880.

Be it known, that I, Emile Berliner, of Boston, Mass., have invented certain new and useful improvements in electrical telephony, of which the following is a specification.

In an application for Letters Patent made by me June 4, 1877, I have

shown how sound may be transmitted and reproduced by means of a vibratory metal or carbon-plate in contact with a metal or carbon pin.

The transmission was made by either breaking the contact or by alternately weakening and strengthening the same at each vibration of sound affecting the plate.

The reproduction of the sound was affected by permitting such a current, thus consisting of electric waves, to pass through a similar receiving instrument, consisting also of a metal or carbon plate in a vibratory position in contact with a metal or carbon pin.

As shown in said application each electric wave passing over the point of contact would cause a recoiling of the plate from the pin. Thereby an air-wave would be produced and, as the electric waves would follow one after the other in exact accordance with the transmitting sound-waves, the air-waves or vibrations produced by the receiving instrument, occurring at the same rate and measure, would therefore reproduce the same tone that affected the transmitter.

Since then I have found that when sound is transmitted by varying the intensity of the current without intensifying the cause — namely, by merely weakening or strengthening the contact at each vibration and thereby the current—the effect on the receiving instrument is not very strong, and particularly at long distances the effect is but feeble, *and requires some attention to be audible.*

I have therefore constructed an apparatus, together with a combination of currents, which will materially assist to remedy the *deficiency* mentioned, first by having not one but several points of contact with one and the same plate, or a modification of such a device, by means of which several contacts are affected simultaneously, and secondly by using a kind of telephone relay or transfer in connection with a local battery circuit. This is shown in the drawings, as follows:

shown how sound may be transmitted and reproduced by means of a vibratory metal or carbon plate in contact with a metal or carbon pin, *so arranged in an electric circuit that a constant-current, as from a battery,* passes through the point of contact which formed part of that circuit.

The impact of sound waves upon said plate in the transmitter caused it to vibrate, and this either broke the contact, *or in the case where articulate speech was required,* alternately weakened and strengthened the same at each vibration of the plate, thereby varied the electrical resistance of the contact, and this varied the strength of the current which was passing the varying point of contact.

The reproduction of sound was *also* to be effected *with this form of instrument,* by permitting a current consisting of electric waves to pass through a similar receiving instrument, composed also of a metal or carbon plate in a vibratory position in contact with a metal or carbon pin.

As shown in said application each electric wave passing over the point of contact would cause a recoiling of the plate from the pin, thereby producing an air-wave, and as the electric waves would follow one after the other in exact accordance with the sound-waves which acted on the transmitter to throw the electric current into waves, the air-waves or vibrations produced by the receiving instrument occurring at the same rate and measure, would therefore reproduce the same tone that affected the transmitter, *but when sound is transmitted* by varying the intensity of the current *by means of this transmitter* without interrupting the same — namely, by merely weakening and strengthening the contact at each vibration, and thereby weakening and strengthening the current—the effect on the receiving instrument is not very strong, and particularly when a long circuit is employed the effect is but feeble.

My present invention relates to an arrangement of circuits and currents which will materially assist to remedy the *weakness* mentioned.

Another Opportunity for American Apparatus.

United States Consul Ashby reports to the Department of State from Dublin, Ireland, that the Dublin United Tramways Company has announced its intention to proceed in the 1897 session of Parliament with bills to permit extensive construction of new lines, and to substitute electric traction for horse-power on existing lines. The company also intends to proceed before the Privy Council for authority to extend, vary and enlarge existing railway lines. The new extensions contemplate a large number of lines connecting the various suburban districts with each other and with the city proper.

The Dublin, Wicklow & Wexford Railway Company will in like manner seek permission to extend its system, and obtain authority to substitute electricity as the motive power to such extent as it may choose. It is stated that this company intends to substitute at an early day electric traction for both passengers and freight on its line from Dublin to Bray, a distance of 14 miles. This decision is thought to be one of the results of the competition of the Southern District Electrical Tramway, which parallels this line for eight miles. The Southern District line, it is stated, has seriously affected the railway's earnings, and is constantly growing in favor with the suburban population. The Municipal Council of Bray is also considering the construction of an electric railway.

Consul Ashby also understands that the Belfast Tramways Company will apply to Parliament for permission to adopt electric traction on the lines of that city. Should Parliament give its sanction to all these enterprises there will be a brisk demand for apparatus, and an opportunity for American manufacturers to develop some good foreign trade.

Converting the Ohm into Watts.

In all other countries the current must be squared, but in Germany there is a project to dam the current in order to get power from the Ohm for distribution to the villages along its banks in the picturesque Ohmer Valley.

Incandescent Lamps.*

BY FRANKLIN S. TERRY.

The making of an incandescent lamp requires more than 30 distinct processes, most of which affect its quality rather than its appearance. The character of the filament, the way it is flashed and the exhaustion may generally be said to have most to do in determining the quality, but the defect in a lamp may be traced to a defect in either the filament, the glass, the platinum, even the base, or due to poor workmanship in any one of the several processes in putting them together. An incandescent lamp is not so simple an article of manufacture as to make it reasonable to expect that all kinds will be the same in quality.

It is customary to state as the efficiency of an incandescent lamp the watts of energy required to produce one candle of light. By increasing the voltage we increase the light more than in proportion to the increase in the energy consumed and the lamp is then said to be more efficient. For example, a lamp giving 16 candle-power of light at 100 volts pressure and consuming 56 watts of energy we would call a 3.5 watt lamp. By increasing the voltage to 104 we raise the candle-power to 20, the watts of energy consumed to 60 and the watts per candle would be three and we would then call it a 3 watt lamp. If we should increase the voltage to 110, the candle-power would be increased to 28, the energy consumed to 70, the watt per candle would then be 2.5 and we would call it a 2.5 watt lamp, There is no difference in the lamp itself between what is termed a 2.5 watt lamp and what is termed a 3.5 watt lamp.

As lamps are operated at a higher efficiency their defects become more apparent. If one is satisfied to operate a lamp at an efficiency of six or seven watts per candle (and such lamps are made and sold), what is in reality a very bad lamp may give such a customer good satisfaction.

The life of an incandescent lamp will be shorter as it is operated at a higher efficiency, or in other words, at a higher voltage. For example, if at 3.5 watts a lamp would have a life of 2400 hours, at 3 watts it would perhaps have a life of 1000 hours, and at 2.5 watts a life of 350 hours. It is not correct to take the life of an incandescent lamp as the measure of its quality. The practice of asking for guarantees of life has been nearly discontinued. The absurdity of such a guarantee is apparent when we consider that the conditions governing the life are under the control of the one operating the dynamo; and further, the life of a lamp is a factor of small relative importance in determining any economy in incandescent lighting. Every manufacturer can make long-life lamps, and those that are interior in quality will usually be found to have a long life.

The decline in candle-power is due to an increase in the resistance of the filament; consequently it then requires a higher voltage to produce the same amount of light as at first. Every incandescent lamp will decline in candle-power after a certain number of hours burning. If operated at a higher voltage or efficiency the decline will be more rapid. The difference between different makes of lamps as to the rate of decline is due principally to the filament used and the exhaustion, and when operated at the same efficiency this rate of decline is the correct measure of their relative quality.

Sometimes central stations raise the voltage that they may give customers a better light, or in order to burn out the old lamps. This is bad practice, as it will result either in burning out new lamps or reducing the candle power until they will no longer give a serviceable light.

Lamps should be "smashed," as it is now usually termed, when they have ceased to give a satisfactory light, and should be replaced by new lamps of full candle power.

The life of a lamp is usually understood to mean the length of time it will burn without burning out. It would be better to use the term "useful life," which would mean until such a time as the candle power has declined so as to give an unserviceable or uneconomical light, which in most cases would be so long as the light was within 25 per cent. of the initial candle power.

The term "efficiency of an incandescent lamp," usually refers to the initial efficiency, and as such does not signify very much. The real efficiency of a lamp is the average efficiency, being the light obtained for the energy consumed during its useful life,

The blackening of a lamp, as is well known, is due to particles of carbon that are driven off from the filament to the glass. This disintegration of the filament proceeds more rapidly when the lamp is operated at a higher voltage.

If a lamp bulb has become black, it is almost a sure indication that

* Abstract of paper read before the Northwestern Electrical Association.

the lamp has been subjected to a higher voltage than was intended, or has been burning a good many hours. Blackened lamps should not be complained of as defective.

Probably there has not been an article written on the operation of incandescent lamps without calling attention to the importance of maintaining a uniform voltage and still this is not fully appreciated in many central stations. The trouble is sometimes due to incorrect station voltmeters, sometimes to large pressure loss on the lines and on alternating circuits may be due to poor regulation of transformers. Every central station should be supplied with standard portable voltmeters, and frequent readings should be taken of the voltage at different parts of the line. It must be remembered that over-ruuning a lamp not only shortens its life but increases the resistance of the filament, so that it will not afterwards give its normal candle power at the normal voltage. A fluctuating voltage must always result in an unsatisfactory lighting service. If it would be an advantage to the central station to have a higher efficiency lamp, the first step to take in that direction is better regulation, which will result in the lamps being of higher efficiency when operated at the normal voltage.

In a paper read at your last year's meeting Mr. Buckley recommended the use of 2.5 watt lamps, "and 2 watt lamps if you can obtain them." You all have 2 watt or 2.5 watt lamps in your stations now. Just increase the voltage at which they are burned until the energy consumed, divided by the candle-power of light, gives you 2.5 and you have a 2.5 watt lamp. If you are using the best lamp you will have the best 2.5 watt lamp that can be made. If you wish a 16-cp 2.5 watt lamp, order of your manufacturer a lamp that will give you 16 candle-power at the voltage you are operating and will consume but 40 watts.

The 2.5-watt lamp would not do at all on most central station circuits as they are now operated. When overrun in voltage they would be immediately burned out or the candle-power would afterwards be so low as to make the light unserviceable. A high voltage will injure so-called high-efficiency lamps more than those of lower efficiency. With better regulation you can use higher efficiency lamps and it is profitable to operate lamps at as high efficiency as will give satisfaction to your customers. Probably a 3.5-watt lamp will give the best satisfaction in most moderate-sized stations as at present operated.

One difficulty in furnishing lamps to central stations is the lack of knowledge of how the station is operated. Often the voltage is higher or lower than is stated, due perhaps to an incorrect voltmeter, and lamps made for the voltage as ordered would not be satisfactory. Again, the voltage may be irregular, and a lower efficiency lamp would be more suitable. If all central stations were operated the same, it would be much easier to furnish a lamp that would always give satisfaction. This will perhaps explain how it is that a certain make of lamp is considered the best at one station and the worst at another.

Managers of central stations frequently buy certain makes of incandescent lamps for the reason that they are 1 cent or 2 cents each lower in price, at the same time admitting that they are not quite so satisfactory in quality. I believe that this is very poor economy.

As the purpose of the business of central station electric lighting is to make a profit and pay dividends to the stockholders, every intended economy must be judged by its effect on the profits or dividends.

Some time ago I obtained from a number of electric lighting central station statistics showing the capital invested and the results of their operation and from an average of these I have made up some figures that I believe fairly represent the results that will be obtained in the average station.

We will take for our example a station having an investment of $100,000.

I found the average gross receipts of the stations above referred to was 26½ per cent. of the investment, or this station should have a gross income of $26,500.

The average price charged customers for energy was 15 cents for 1000 watt hours, which would be equivalent to 3 to 4 cents per lamp hour for a 50-watt lamp.

The electrical energy that this station would supply to customers in a year would, therefore, be 175,666 kw-hours.

Operating expenses, including general expenses, taxes and ordinary repairs for the year, $14,700, or about 8.3 cents per kw-hour.

If the business is profitable the earnings should be sufficient not only to pay dividends, but in addition provide for a reserve or sinking fund, in order to return to the stockholders their original investment at the end of the natural life of the business, and the smallest amount that should be laid aside for this purpose is 5 per cent. of the capital annually, or for this station on the sum of $5,000, or about 3 cents per kw-hour, for the energy delivered to customers.

This would leave a sufficient amount to pay dividends at the rate of about 6.5 per cent., which certainly is not too large, considering the character of the investment.

Now let us see what part of the cost of operating expenses is the item of lamp renewals.

A 50-watt, 16-cp lamp, we will assume, will have a life of 600 hours, or the total consumption of energy of this lamp during its life will be 30,000 watt-hours.

If the cost of the lamp is 18 cents each, this will be equivalent to $\frac{6}{10}$ cent per 1000 watt-hours, or $7\frac{2}{10}$ per cent. (about $\frac{1}{14}$) of the operating expenses, or including the reserve fund, which is a legitimate item of the cost of operating, the cost of lamp renewals will be 5 per cent. (or about $\frac{1}{20}$) of the total cost of energy.

What effect would one cent difference in the cost of each lamp have on the dividend rate?

Taking the total energy generated for the station referred to above, 176,666 kw-hours, and dividing by 30 kw-hours, the energy consumed by each lamp during its life, we find that this station would annually consume 5888 lamps,

A difference in price of 1 cent per lamp would therefore amount in a year to $58.88, or 1/17 of 1 per cent. of the investment, or it would take 17 years for 1 cent added to the price of lamps to equal 1 per cent. of the capital stock.

Now let us turn to the question of quality.

It is ordinarily stated that the energy consumed by an incandescent lamp is transformed, about 95 per cent. in heat and 5 per cent. in light. Considering for a moment the lamp to be a device for generating heat, we would certainly expect to find that two different makes would differ from each other at least 1 per cent., or if one lamp transformed 95 per cent. of its energy into heat, we might reasonably expect another would transform 96 per cent. into heat. These would not then differ from each other very much in their general conditions, but one would transform 5 per cent. of its energy into light and the other 4 per cent., or in the amount of light produced for the same consumption of energy they would differ from each other 20 per cent. I have stated it this way to show that such a difference cannot be considered absurd.

What is the value of this difference to the customer?

If the customer pays ¼ cent per lamp-hour and a lamp burns 600 hours, he pays for the energy consumed for that lamp during its life $4.50, and as light is the only product that is useful to the customer, a difference of 20 per cent. in the amount of light obtained from two different lamps would be a difference in value to the customer of 90 cents.

I have seen tests of different makes of incandescent lamps showing even a greater difference than that stated above.

If the central station pays for the lamps and the customer for the energy it might at first appear that a higher lamp cost, even if it did result in a better lamp and benefit the customer, would be an additional expense to the station for which it would receive no additional revenue. In considering this phase of the subject we should have in mind that any probable difference in the cost of a lamp would, as I have shown, make but a very slight difference in the earnings of the central station, but a slight difference in the quality of the lamp would make considerable difference in the value of light to the customer. In other words, by a small additional expenditure you would add considerably to the value of what you deliver to your customer. I believe that it is a well-established rule of business that those business enterprises are in the end most prosperous where the customer's interests are most carefully considered.

I remember several years ago being informed by one who had made a study of the operation of a number of large central stations, that those stations that were the most liberal in their lamp renewals were the most prosperous.

The use of a lamp that is inferior, I believe, will always result in reduced profits to the station, even if the lamp should cost nothing.

Large expenditures are made to obtain economical generating apparatus for the purpose of converting electrical energy into light and the device that must be depended upon to make the final conversion —the incandescent lamp—is often almost disregarded as a subject of careful study and investigation, although the results of the investment that has been made largely depend upon its operation.

The Enclosed Arc Light.

BY L. B. MARKS

(*Continued from page 132.*)

HAVING thus reviewed the fundamental conditions governing the operation of enclosed arcs, we will now confine our attention to the most important phase of the subject, namely, the high potential enclosed arc.

Pioneer High-Potential Enclosed Arc Lamp.—We have seen that all the types of enclosed arc lamps described up to this point have been deficient in various particulars. As far as commercial operation is concerned, none of them has been a success. It remained for a lamp operating on a new principle to fulfill the requirements exacted by the commercial practice of the day. Such a lamp had to satisfy the following conditions:

First, Standard steady light of uniform distribution.

Second, Efficient arc.

Third, Long life of the carbons.

Fourth, No blackening or discoloration due to the disintegration of the carbon.

These conditions were fulfilled in a lamp, an account of which I presented for the first time before the National Electric Light Association of America in February, 1894, and which I called the high-potential incandescent arc. The high-potential enclosed arc, as its name indicates, was so called on account of the high voltage of the arc. High voltage is of course a relative term, and is applied in this case in contrast to the usual voltage of the arc, *viz*: 40 to 45 volts. In experimenting in this line I found that arcs could be steadily maintained at double the voltage of the ordinary arc, and under some conditions even at three or four times the voltage. Arcs of such high voltage are naturally quite long and require apparatus specially adapted to operate them. I found that under proper conditions these long arcs could not only be maintained continuously, but so operated with a remarkably small current, thus resulting in high efficiency and long life of the electrodes. Experience has shown that this method of operation is the only one which has been successfully applied to existing commercial circuits. A glance at the cut in which marginal notes indicate the principal parts of the lamp will show that the operating mechanism consists simply of a pair of solenoids, armature and cores, lazy clutch and carbon rod. This mechanism is designed so as to spring a long arc of about 10 millimetres or more. The design of the solenoid is such that the current consumed by the lamp will be very small and quite uniform throughout the range of the lamp. The enclosing bulb is mounted in the lower carbon holder, and as will be seen from the notation on the cut, is closed at the top by a special device known as a gas-check plug. The lower carbon in this lamp is 12 centimetres long and the upper carbon 30.5 centimetres long; both pencils have a diameter of 11.11 millimetres. At the top of the lamp is mounted a small resistance coil. The standard lamp is designed to pass a current of from four to five amperes, 80 to 85 volts being the drop across the arc.

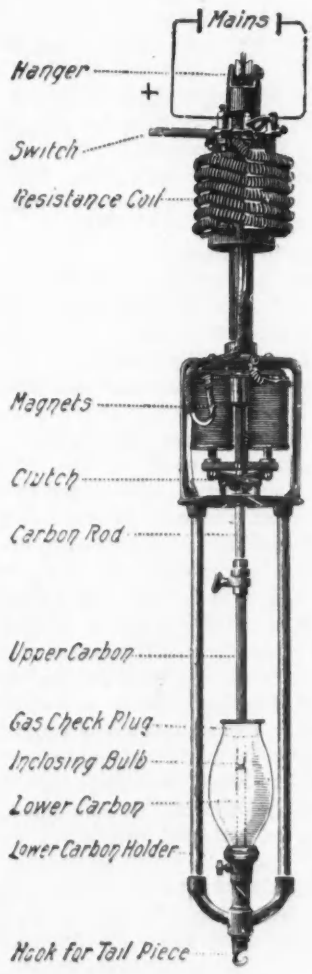


FIG. 4.—LAMP DETAILS.

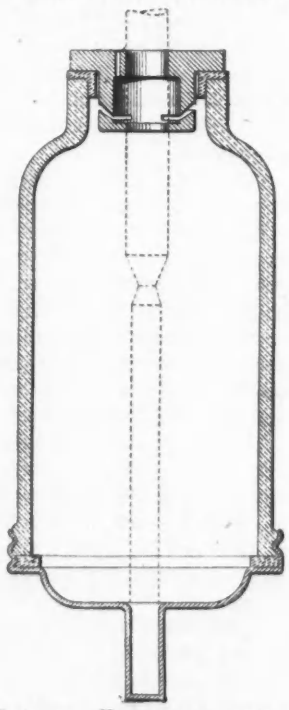


FIG. 5.—ENCLOSURE WITH GAS CHECK PLUG.

The Gas-Check Plug.—The plug which forms a closure for the bulb is such a unique device that I have deemed it worthy of a special representation in another cut, where you will note the gas-check plug is shown in cross-section mounted in the mouth of a cylinder. If we close the mouth of the bulb simply by a flat metal disc, having an opening in it sufficiently large to allow for variation in diameter of commercial carbons, we find it difficult to prevent an abnormal acccess of oxygen into the enclosure. The gas plug was devised to check the circulation of ingress and egress and still have the same sized opening leading into the enclosure. The comparative measurements with and without the gas-checking device will be given later on.

FIG. 6.—ENCLOSING BULB. LOWER CARBON HOLDER; (SUPPORTS THE BULB).

It will be noted that in order to retard or check the flow of gases into and out of the bulb, the plug is provided with a depending cylindrical metal tube about 1.5 centimetres long, the lower end of which is slotted so as to allow of communication between the gases on either side of the wall formed by the tube. The opening around the carbon may with advantage be enlarged so as to form a secondary chamber for gases, as shown in the cut. Now after the lamp has been in operation for a few moments the heated gases from the arc instead of having unobstructed egress are met by another body of gas at the plug resulting in the production of eddy currents which tend to check the circulation of the outgoing and incoming gases. I have in my hand a model illustrating the principle of the gas-check plug. Instead of the lower carbon I use an ordinary wax candle. Instead of the upper carbon I use a strip of metal to serve as a longitudinal diaphragm adapted to show the circulation of the gases. The depending cylindrical metal tube which pro-

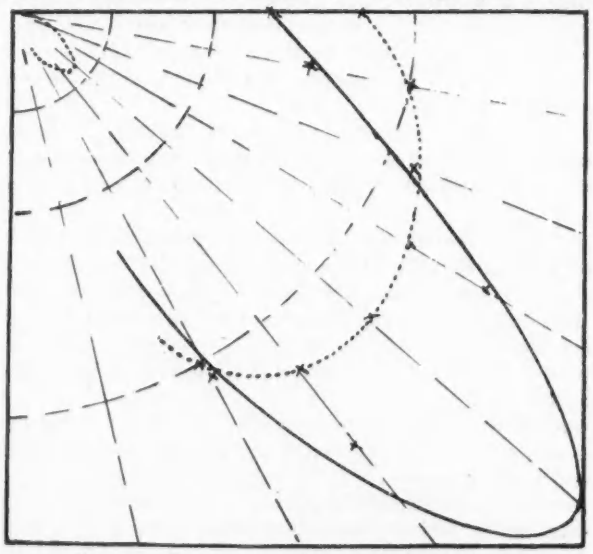


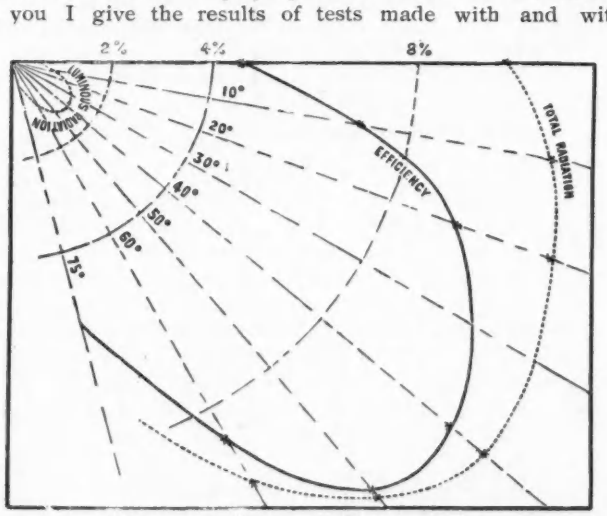
FIG. 7.—EFFICIENCY CURVE OF OPEN ARC.

jects into the bulb is provided at its lower end with slots just as explained before. In order to show the gas-checking action very distinctly I have arranged to open and close the slots at will. The conditions, you will see, represent exactly those which exist in the case of the lamp. I now light the candle. If I remove the metal strip which forms a dividing wall for the gases, the circulation of air into the enclosure will be stopped almost instantly and the candle goes out. If the strip be inserted, thus representing the upper carbon in its normal position in the lamp, and the candle be relighted, you will note that the flame continues to play, the cool air finding a path for admission on the one side and the heated gases having an unobstructed egress on the other. Thus far the slots in the depending tube have been closed. I now open these. You will note that the circulation of gases is quickly checked and the flame grows dimmer and finally becomes extinguished. The heated gases are diverted in their course, and instead of being freely out of the enclosure, tend to fill the bulb with a deoxygenated atmosphere, thus illustrating the action of the gas-check plug of the enclosed arc lamp.

III —TABLE OF LIFE TESTS, WITH AND WITHOUT GAS-CHECKING ATTACHMENT. CARBONS 11.11 MILLIMETRES IN DIAMETER.

Mean current (amperes).	Mean arc tension (volts).	Mean energy (watts)	Consumption of (+) carbon per hour (in millimetres).	Consumption of (—) carbon per hour (in millimetres.	Total consumption of carbon per hour (in millimetres).	Remarks.
7.98	63 36	509.65	2.118	0 538	2.656	No gas-check.
7 99	63 4	506.56	1.483	(—) 0.152	1.331	gas-check.
8.03	61.77	496.12	2.751	0 424	3.175	No gas-check.
8.06	63.5	511.61	1.161	(—) 0.076	1.085	gas-check.

Life Tests. — First, with and without gas-checking attachment. The use of the gas-check plug makes it possible to prolong the life of the carbons far beyond that which can be reached without employing this device. In the table before you I give the results of tests made with and without



EFFICIENCY CURVE OF ENCLOSED ARC.

the gas-checking attachment, other conditions being practically the same. You will note that in one of the tests the total consumption of carbon with the gas-check plug was only a trifle over one half and in the other a shade more than one third of that resulting from the omission of the gas-checking attachment. The prolongation in the life of the negative electrode was exceedingly marked, the latter having increased in length in each case when the gas-checking attachment was used.

Second, with carbons 11.11 millimetres in diameter in five-ampere lamp. A pair of carbons, which in the ordinary open arc will burn for six to eight hours, will last from 100 to 150 hours in commercial practice in the high-potential enclosed lamp, which I have already described to you. A life test of a pair of carbons 11.11 millimetres in diameter, operated in the standard lamp, is given below. This is a report on the performance of a lamp which is in service about four hours every day. The total run was 121 hours.

Third, with carbons 12.7 millimetres in diameter in four-ampere lamp. When the diameter of the carbons is increased the longevity is greater, but other objections are introduced which will be treated of under the heading of "Efficiency of the Enclosed Arc." The life test of a pair of carbons 12 7 millimetres in diameter, running about 12 hours per day in a four-ampere lamp, is appended:

IV.—TABLE OF LIFE TEST OF CARBONS 11.11 MILLIMETRES IN DIAMETER, IN "PIONEER" FIVE-AMPERE ENCLOSED ARC LAMP.

Original length (+) carbon	= 306.387 millimetres.
Original " (—) "	= 121.10 "
Final " (+) "	= 100.537 "
Final " (—) "	= 82.55 "
Total run	= 121. hours.
Consumption (+) carbon per hour	= 1.652 millimetres.
" (—) " " "	= 0.319 "
Maximum current	= 5.25 amperes.
Minimum "	= 4.65 "
Average "	= 4.95 "

V.—TABLE OF LIFE TEST OF CARBONS 12.7 MILLIMETRES IN DIAMETER, IN "PIONEER" FOUR-AMPERE ENCLOSED ARC LAMP.

Original length (+) carbon	= 304.80 millimetres
Original " (—) "	= 128 587 "
Final " (+) "	= 114.30 "
Final " (—) "	= 77.787 "
Total run	= 199 hours
Consumption (+) carbon per hour	= 0.957 millimetres
" (—) " " "	= 0.255 "
Maximum current	= 4.5 amperes
Minimum current	= 3.8 "
Average current	= 4 15 "

Efficiency of the Enclosed Arc.—On a previous occasion I published some curves showing the relative radiant efficiency of the enclosed arc, one of which curves I will reproduce here for you in contrast with an efficiency curve of an average open arc. Referring to the figures, the dotted line curves indicate the relative luminous and total radiation respectively. The ratio of the luminous to the total radiation of the lamp at various angles below the horizontal is given in the heavy line curve, which therefore represents the radiant efficiency of the arc. In the case of the enclosed arc the measurements are given for a clear glass enclosure ; in the case of the open arc the readings are given for the naked arc, no globe having been used. The mean hemispherical efficiency of the enclosed arc was found to be 8.4 per cent.; that of the open arc for the same current 11.7 per cent. It will be noted that the efficiency curve of the enclosed arc differs materially from that of the open arc, the distribution of light in the former being more uniform than that of the latter. In the enclosed arc the change in efficiency from 20 to 60 degrees is inconsiderable, while in the open arc the change is decidedly marked, the curve taking a very sharp turn at about 40 degrees.

The figure which I have given for the efficiency of the naked arc is much higher than that of the average naked arc in service in the United States. From tests which I have made, it is safe to say that as commercially operated the average efficiency of the open arc lamps falls considerably below 10 per cent., without deducting the loss due to the interposition of a clear or translucent glass globe. When we consider the case of an open in-door lamp with an opal globe, such as used extensively in this country, and compare the same with that of an enclosed arc lamp as commercially operated, the relative radiant efficiency measurements as given above do not represent the true relative illuminating powers in the two cases. With the open arc for in-door illumination, it is necessary to soften the light; in other words, to enlarge the area of the source of illumination. With the common opal globe it is found in practice that from 40 to 60 per cent. or more of the light is necessarily cut out in obtaining the requisite distribution just alluded to. With the enclosed arc, on the other hand, where a thin outer globe is used, this distribution can be obtained with a loss of not more than one half of that in the case of the open arc, especially when the inner bulb of the enclosed arc is made of a slightly translucent glass.

(To be continued.)

Röntgen-Ray Investigations in Vienna.

The London correspondent of the New York *Sun* states that several discoveries connected with Röntgen-ray investigations have been recently reported from the European continent. That of Prof. Friedrich, at the Vienna Academy of Sciences, is the most important. The professor, it is stated, discovered that certain black rays issue from the vacuum tube and pass through the human body. The photographs produced by means of these rays, which the professor calls "critical rays," are not the same when taken from a living body as from a dead one. Photographs of living hands show the skeleton as in the Röntgen-ray radiograph, but a dead hand appears in full, showing all the fleshy integument, while the bones remain invisible. Dr. Freund, also of Vienna, it is reported by the same authority, tried Röntgen rays upon a boy whose spine was hidden by an abundant crop of hair, the object being to remove the hair. The experiment, it is stated, was entirely successful, and all the superfluous hair vanished, roots and all.

On the Prospective Development of Ether Theories.

To the Editor of The Electrical World:

Sir:—In your editorial column of the issue of Jan. 2, some remarks are made with reference to my note on ether theories, contained in the same issue, and some doubt is expressed as to the value of the methods used.

Of course, in the end, the value of a method lies in the results which it gives, and I expect shortly to show that this method does give valuable results which cannot be obtained by any other means known at present.

It seems to me, however, that in the mean time some reply to the objections raised is called for.

In the first place, it is argued that "by the treatment he uses little more is to be derived from the mathematics than that which is put in them."

This objection I cannot regard as valid. If I may, without offence, confess a weakness, I would say that the conception that there exists somewhere in space a region where mathematicians labor under the perplexing disadvantage that things not contained in their assumptions intrude themselves during the subsequent analysis, seems to me sufficiently diverting. But unfortunately, in this sombre and law-abiding world of ours, we must look long and in vain for such an agreeable phenomenon. As a matter of fact, if, in a piece of mathematical work, we find anything that is not implicitly contained in the original assumptions, we know at once that the reasoning is faulty. In this respect therefore the methods used by me do not differ from the well recognized methods.

Since, however, this objection has been made to my work more than once, and even by mathematicians of acknowledged ability, I would like to point out just what the function of mathematics is.

A mathematical research is very much like prospecting for minerals. We lay off a claim in a certain region of physics. The extent of this claim we fix by mathematical boundary pins, these being our preliminary assumptions. Then the mathematical working of the claim tells us three things:

1. What is contained in our claim. This is obtained directly.

2. What is not in our claim. This we get by comparison or other facts, which we know, with what is contained in our claim.

3. It tells us in what direction we must shift our fundamental assumptions in order that our claim may contain what we wish it to. This we find by shifting the assumptions in different directions and noting the effect.

Strictly speaking, however, the only thing that mathematics can do directly is to explain more fully what our original assumptions mean. This is the easy part of the work. The really important parts are, first, the instinct which tells where to set the pins, and, secondly, the knowledge necessary to tell us what is not in the claim.

Unfortunately a mathematical surveying pin, unlike a material one, can be stuck anywhere; over a transcendental abyss, or in an indeterminant bog. If we make to ourselves theories of elasticity on the assumption that it is proper to consider the elasticity of cork and of steel as of the same nature; if we form theories of contact electricity, neglecting the influence of the air; of thermo-electricity before we are certain that there is such a thing apart from chemical action; of the limit of geological time without regard to the jacketing effect of an atmosphere, then we are placing out mathematical surveying pins in unsafe places, and our work can hardly be productive.

Now the main reason that I have adopted dimensional methods, after trying the usual methods, is that they enable one to obtain a bird's-eye view of physics, and show where to work. For instance, if I find that among the ethers of the second class mentioned in my note, that in which $Z = 1/T$ (for a recent experiment has shown me that the second class is not limited to one, as at first supposed), seems for some reason to be probable, then I know that there should be a magnetic effect produced by the acceleration of matter.

In regard to the question concerning Maxwell's electromagnetic theory of light, I would say that my reference having been to Maxwell's letters, it might have been wiser to have referred to them instead of to his papers before concluding that my memory was at fault. There seems to be some misconception as to what Maxwell did. He did not suggest that the same ether was concerned in both light and electric phenomena, as Faraday had done that before. He was not the first to suggest that electric effects were propagated with the velocity of light, as Faraday suspected that (letter from Faraday to Maxwell, March 25, 1857). What he did was this: A formula may be obtained for transverse electromagnetic vibrations. This formula is not the same as that for an incompressible elastic solid; but if we assume that $K\mu$ equals the reciprocal of the square of a velocity, then the equations become similar, and this velocity is the velocity with which the vibrations move. Then he found that the square root of $K\mu$ was also the reciprocal of the ratio of the electromagnetic and electrostatic units of quantity of electricity, and that this ratio was the velocity of light.

The question is whether the equations suggested the writing of $K\mu$ in terms of velocity, or whether the knowledge that $K\mu$ was a function of a velocity suggested the equations. As mentioned in the note, my impression is that the latter was the case, but it was nearly 10 years ago since I read the letter, and my memory may be at fault. I believe the letter was to Fleming Jenkin.

Allegheny, Pa. Reginald A. Fessenden.

Progress in American Telegraphy.

To the Editor of The Electrical World:

Sir:—"It makes no matter how many words can be electrically transmitted over a wire per minute from one continuous tape, the practical working limit of the wire is reached in handling the message at the sending end."

I quote the above from Mr. F. W. Jones' very interesting chronological account of "Progress in American Telegraphy" which was printed in The Electrical World, Jan. 2, 1897.

I would like to know what Mr. Jones means by "one continuous tape"? I know of no system of telegraphy using such a thing.

In automatic transmission there are short tapes and long tapes, according to the exigencies of the case or character of the business.

Urgent telegrams might be punched and transmitted singly. Ordinary business, to borrow the language of an Indiana statesman, might be sent "in blocks of five," while press news might warrant a thousand words at a time, but assuming that each message is handled singly, and that one half the time is used in putting fresh tapes into the transmitter, is it immaterial whether transmission is carried on for the balance of the time at the rate of 20 words a minute or 2000. Would it not be just as reasonable to say that the speed of a Morse operator was of no consequence so long as no time was wasted in handling, *i. e.*, starting, a message?

I think Mr. Jones is too good a logician and too able a telegraphist to reflectively adhere to any such proposition.

Patrick B. Delany.

South Orange, N. J.

The Berliner Patent.

To the Editor of The Electrical World:

Sir:—It is not my desire to enter into an extended argument on the contents of your editorial of Jan. 9, 1897; but I should like to state that April 14, 1877, and not June 4, 1877, is the date when I fully disclosed to the Patent Office the principle of transmitting speech by the variation of pressure of a constant contact.

The June 4 application was a document garbled through the ignorance in the science of telephony of the clerk who wrote it and causes are fully set forth and proven in the pending suit.

I must also take exception to the hypothesis that the microphonic action is necessarily or at all due to a difference in the number of molecules in contact.

A careful perusal of the briefs filed in the pending suit should convince an unbiased critic that there is perhaps a little more merit on the side of the American Bell Telephone Company than its enemies would like to make it appear. The latter are really working on the principle of "throw enough mud and some may stick."

E. Berliner.

Washington, D. C.

Use of Sine Curves in Alternating-Current Problems.

To the Editor of The Electrical World:

Sir:—In your issue for Jan. 16 a digest reference (page 100) referring to an article on the "Use of Sine Curves in Alternating-Current Problems," by Rhodes, states that: "The virtual value of functions containing only odd harmonics depends solely on the amplitudes of these harmonics, and is independent of their phase positions." It is interesting to note that this conclusion agrees so closely with a statement made in The Electrical World, July 18, 1896 (page 76), in an article by Prof. Boyd and myself, our conclusions being: "The magnitude of the virtual value of a function made up of odd harmonics depends only upon the amplitude of these harmonics, and is independent of their phase positions." Frederick Bedell.

Ithaca, N. Y.

DIGEST OF CURRENT TECHNICAL ELECTRICAL ARTICLES COMPILED FROM FOREIGN AND AMERICAN JOURNALS

BY

CARL HERING

DYNAMOS, MOTORS AND TRANSFORMERS.

Calculation and Estimation of Dynamos. ARNOLD. *Elek. Zeit.*, Jan. 7; a short communication supplemental to the article noticed in the *Digest*, Jan. 9.—In the original he stated that the parallelogram of forces can be applied to the combining of E. M. Fs. only when the parts of the circuit at which the different E. M. Fs. are induced, are magnetically independent of each other, or when this is not the case then only so long as the magnetization curve is a straight line. To this he now adds that it is hereby assumed that the E. M. Fs. are single and are calculated independently of each other from the respective magnetization forces, the ampere turns, the frequency, etc. In the reversed process in which one starts with the resultant E. M. F. and decomposes the same into two or more components, the impedance of the single components can then always be determined, and the parallelogram may be applied.

Armature Reaction in Dynamos. ROTHERT. *Elek. Zeit.*, Jan. 7.—A communication in reply to that of Behn-Eschenburg; he points out a characteristic difference between the latter's views and his.

Magnetic Dispersion and Armature Reaction. VOGELSANG. *Elek. Zeit.*, Dec. 31.—A continuation of the discussion which has been conducted in that journal; in the present portion he discusses chiefly transformers having an air space in the iron circuit.

Combined Engine and Alternator.—Lond. *Engineering.* Jan. 1.—An illustrated description of the 270-hp fly-wheel alternator to be used at the Bolton station, the alternator being of the Ferranti type; the tabulated results of trials are given, in which the combined efficiency was shown to be 84.4 per cent at half load and 90 per cent. at full load.

Practical Method of Compounding a Shunt Motor for Constant Speed at All Loads. HUTCHINSON. *Amer. Elec.*, January.—The motor is simply compounded with a series-coil, the ampere-turns of which are in the opposite direction to those of the shunt coil; he explains the well-known method of measuring the number of turns by means of a trial coil.

Faults in Transformers.—Amer. Elec., January.—Descriptions of simple tests for finding grounds, short circuits, open circuits and imperfect magnetic circuits.

The Rotary Balance Coil.—Amer. Elec., January.—An account of the principles of the well-known rotary balance coil, sometimes called the rotary equalizer, consisting of two armatures on the same shaft, for equalizing the E. M. Fs. of a three-wire system.

Inoperative Unipolar Machine. MARKLE. *Elec. Eng.*, Jan. 20.—A brief account of a unipolar machine that would not generate a current; the basic principle was that the conductors should be connected in series by a wire which partially "evaded the magnet lines," but it did not do so, as the machine did not produce the slightest E. M. F. He claims that the present theory of cutting lines of force does not show wherein the method fails; and concludes that this theory is at fault and is absolutely erroneous. (In this he is in error, as that theory explains it very well; lines of force are persistent, and cannot be evaded or open circuited; a wire enclosed in an iron tube when moved through a field will generate precisely the same voltage as it would without the tube, provided the tube does not alter the total number of lines generated; such a tube does not shield the wire.)

LIGHTS AND LIGHTING.

Cost of Lighting from Public and Private Supply. WARDEN-STEVENS. *Elec. Rev.*, Jan. 8.—A description of some curves which he has prepared of the cost of electric lighting from a station and from a private plant in order to show approximately when it is advisable to adopt a separate private plant. He considers gas-engine plants of less than 50 horse-power and makes a number of assumptions, all of which are clearly stated; the private plant includes accumulators, and the price of gas is taken as 62 cents; all the expenses common to both systems are not considered; the curves give the relations between the cost per annum and the number of 8-cp lamps; one of them is based on 15 kw hours per 8-cp lamp per year and the other on 30-kw hours; they can be readily altered to suit other assumptions. There are quite a number of factors which enter, and therefore no final conclusions are arrived at; he points out that the units consumed per 8-cp lamp per annum and the usual maximum demand have a great deal to do with the question when it will be better to install a separate plant, and that unless these figures are known no intelligent answer can be given. In an example which he works out the lowest figure is 175 and the greatest 1200, which explains to some extent the widely different results given by experts to the same question.

Lighting Statistics.—Elec. Eng., Jan. 20.—A reprint of some of the curves and other statistics from the Lond. *Elec.*, which were noticed in the *Digest*, Jan. 16.

Use of High-Voltage Lamps. ADDENBROOKE. *Electricity*, Jan. 20.—A reprint of the article abstracted in THE ELECTRICAL WORLD, Jan. 16, page 94.

POWER.

St. Petersburg.—Elek. Anz., Dec. 20.—A note stating that the rapids of Imatra, near Narva, Finland, are to be used for lighting St. Petersburg.

Steam Engine Governor for Electrical Work. TAYLOR. Lond. *Elec.*, Jan. 15.—An illustrated description of a new governor.

Influence of Electricity in the Mining Industries. HALE. *West. Elec.*, Jan. 23; reprinted from the *Mining Industry and Review.*—He gives a brief description of some of the plants, chiefly in the West. He states that 50 mining and ore-treating companies in the Rocky Mountain district have electric machinery aggregating nearly 11,000 kilowatts of generators and 5,201 horse-power of motors.

Electric Elevators in Germany.—West. Elec., Jan. 25.—A reprint of the illustrations with a short description, from the article noticed in the *Digest*, Oct. 24.

TRACTION.

Electric Railway Statistics in Germany.—Elek. Zeit., Jan. 7.—A large seven page table giving the name of each line in operation and in progress of erection on August 1, 1896, with some tabulated data for each. There were then electric railways in 42 German cities, while in 32 others new lines were to be or were being introduced; the total length of lines in operation is 854 km, and the number of motor cars 1571, besides 998 trailers; 845 km are under construction; the total power is 18,500 kilowatts. The overhead trolley system predominates by far; the underground conduit system is used on two short portions; the accumulator system is used only at Hagen and Eckesey; the mixed system (accumulators and overhead combined) is in use on a short part in Dresden, and to a large extent in Hanover; stationary accumulators parallel with the dynamos are used for the Meckenbeuren-Tettnang and the Remscheid (see *Digest*, last week). This is the first attempt at a systematic tabulated report, but it is not correct in all details. The average kilowatt per km is 25.6 and the average kilowatt per motor car is 15.0. In an editorial reference to the table, a short historical summary is given; electric traction was first started in Germany in 1879 at Berlin, the current being taken from a surface conductor between the tracks; the first permanent installation was made in 1881 near Berlin; in 1882 Siemens and Halske made experiments by taking current from two overhead wires by means of a little car traveling over them and having eight wheels; in the same year the line from Moedling to Vienna was constructed, and in 1884 the one near Frankfort-on-the-Main, in which slotted overhead tubes were used as conductors, the contact plow being a spindle contained in the tube; electric railways, however, were not used to any extent in Germany; in 1885 the first electric railway in America was constructed between Windsor and Baltimore, and in 1891 the first trolley line in Germany was built in Halle.

Traction Motors. ZIFFER. *Elek. Anz.*, Dec. 24.—The conclusion of his long serial, which has been noticed before in these columns. Summarizing the subject he states that in general considerable progress has been made in mechanical traction; steam motors are best adapted outside of large cities and for connecting two cities; they have lately received but little attention; the Serpollet steam car is adapted to be used in cities and suburbs; it is simple in construction and costs but little for first cost and maintenance; compressed-air motors are still in the experimental stage; they have advantages for use in cities; there is as yet no reliable data for the installation and operation costs; cable lines are receiving some attention in Europe, owing to their applicability to roads with heavy grades; the cost of operation for a dense traffic is much less than those of other systems; gas motors have not yet passed the experimental stage; the first cost and cost of maintenance are not too high; the electric motors are used most largely, and are especially adapted for short distances and dense traffic; it is probably the system of the future; the

first cost and cost of maintenance depend on the system used; the question which is the best system to be used cannot be answered off-hand, as it depends largely on the conditions; unless the conditions are the same a comparison of the costs is not fair.

Jungfrau Railway.—Elek Anz., Dec. 24; reprinted in the Lond. *Elec.*, Jan. 8.—A list of the successful competitors for the prizes which were offered, amounting to $6,000; in all 16 prizes have been awarded, chiefly for methods of building tunnels; the first was for a new rack system, and the third for the power station and electrical appliances, the competitor for the latter being the Brown-Boveri Company; only one was awarded to an American, named Halder, for electrical appliances. Two-thirds of the permanent way of the first section of the Eiger glacier is already completed, and it is thought will be opened in August.

Heilmann Locomotives.—Rev. Gen. d's Sciences, Dec. 30.—A description with an illustration showing the outside and some of the details of the new locomotives, the data for which has already been given in these columns.

Motor Vehicles.—L'Energie Elec., Jan. 1.—Illustrations of a number of the carriages shown at the recent cycle exhibition in Paris with brief description of each; among these is the one of Darracq, some of the data for which was given in the *Digest*, last week.

Prizes for Motor Vehicles.—Lond. *Elec. Rev.*, Jan. 15.—An announcement that prizes will be offered by the Royal Agricultural Society in June.

Repair of Electric Railway Apparatus. Shepard. *Amer. Elec.*, January.—An article explanatory of a full-page table giving the various faults to which railway motors are subject, their causes, the means of their detection and prevention, and the remedies to be applied. The faults are classed under field coils, armatures, controllers, auxiliaries and motors, each of which heads is sub-divided.

Annual Reports of Electric Street Railway Companies.—West. Elec., Jan. 23.—Abstracts of the annual reports with some of the tabular data, including cable, the horse and electric lines.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Cologne.—Lond. *Elec.*, Jan. 8.—A brief abstract of a report of the operation of this station up to March of last year. The cost of production is 2.88 cents per kw-hour, not including interest or sinking fund; private lighting consumes 81 per cent. and motors 7 per cent. Each lamp installed burned on an average 463 hours during the year; the maximum demand was during the month of December when the average number of burning hours per lamp was 62; the greatest momentary demand on the station was 37 per cent. of the total lamps installed; the total lamp and motor connection amounts to 34,028 lamps of 50 watts.

Munich. Uppenborn. *Elek. Zeit.*, Jan. 7.—A long, well illustrated description of the central stations in Munich, some of which are run by water power supplemented with steam power; both the two-wire and the three-wire systems are used, as is also a battery of accumulators.

Birkenhead.—Lond. *Elec. Eng.*, Jan. 15.—A long, well illustrated description of this station. A two-wire, 230-volt, continuous-current system is used, the arrangements being made to change this over to a three-wire system at 460 volts when the demand warrants it; the switchboard, feeders, etc., are designed for the three-wire system; there are now three steam dynamos of 80 horse-power each; accumulators are also installed with a capacity of 750 amperes; an illustrated description of the underground mains is included.

St. Helens.—Lond. *Elec. Eng.*, Jan. 15.—A well illustrated description of this small alternating-current plant of about 3000 lamps of eight candle-power owned by the municipality; one of the generators is a large fly-wheel alternator of 100 kilowatts.

A Circuit-Breaker Indicator.—Amer. Elec., January.—A description of a "Kink" whereby it may be determined whether the cause still exists after a circuit-breaker falls; when the circuit-breaker falls out a switch is moved by hand to a point connected with five lamps, which will light up if the trouble is still on, but will remain dark if everything is clear again for throwing in the circuit-breaker. The switch is made with points to connect with any number of circuits leading out from a station; at night one point connects with a circuit used to light the switchboard; when the line is clear the lamps will show red and come up bright when there is a short circuit.

Storage Battery Plant.—Elec. Eng., Jan. 20.—A brief, illustrated description of the new plant of the Hartford Electric Light Company, the battery having been added to relieve the local plant; it has a capacity of 10,000 ampere-hours; the original water-power can now be used every hour in the day when there is water in the river, thus the power costs nothing; it is claimed that the battery plant will pay for itself in three years.

Arc Circuit Troubles.—Amer. Elec., January.—An account is given of a case where in starting up with a circuit of fifty 8-ampere lamps only six amperes could be gotten from the dynamo; increasing the speed of the machine from 1000 to 1400 revolutions did not avail; the circuit was then carefully inspected and finding that many lamps burned blue, the arcs of all these were cut down until they gave a proper light; a dozen or more having been thus adjusted it was found upon returning to the station that difficulty was being experienced in keeping down the circuit; the next day the engine governor was brought to its normal speed and no further trouble was experienced.

Equalizer.—Amer. Elec., January.—An article on the running of compound-wound dynamos in multiple, with a discussion of the principles of the equalizer. Compound dynamos of different sizes, it is stated, will only regulate with an equalizer when the series-field resistances are inversely proportional to the currents they must carry at full load; therefore, if this proportion does not exist, resistance must be added to one field or the other. Numerical instances are given showing the amount of resistance to be added in cases cited.

Evolution of the Isolated Electric Plant. Davis. *Elec. Eng.*, Jan. 20.—The conclusion of his article.

ELECTRO-PHYSICS AND MAGNETISM.

Resistance to Discharges. Cardani. Lond. *Elec.*, Jan. 15; a translation in abstract of an article from the *Nuovo Cimento*, August, on "Thermal Phenomena of Discharges in Derived Circuits" which forms the concluding part of the paper noticed in the *Digest*, Jan. 18, 1895. He describes experimental researches undertaken to investigate the following points: "To establish, by means of the thermal phenomena developed in derived circuits, the law according to which the resistance of metallic bands varies with their sectional areas; to compare, by the same means, the resistance of conductors of equal sectional areas, but of circular and rectangular shape respectively; to determine the influence (if any) upon the resistance of a conductor exercised by the dielectric which surrounds it; to test the advantage of a strand of insulated wire over a single conductor of equivalent sectional area." His conclusions are as follows: "Metallic bands present a much smaller resistance than wires of equal sectional area; the resistance of bands of small thickness in comparison with their breadth (under one tenth) is independent of their thickness; under the usual conditions, the dielectric surrounding the conductor has no sensible influence upon its behavior; wire ropes have only very little advantage over cylinders of equivalent sectional area, as they possess practically the same resistance to discharges; the use of covered wires offers no special advantage, since their somewhat lesser resistance is not due to their insulation, but their geometrical separation; the best arrangement for facilitating discharges is that of multiple parallel circuits, for when they are sufficiently far apart their conductivity increases simply as their number.

Discharge Knobs. Swyngedauw. *Comptes Rendus*, No. 26; noticed briefly in the Lond. *Elec.*, Jan. 15.—He investigated the effect of polish or tarnish; a distinction must be made between the static and the dynamic spark potential; the former remains constant, or even diminishes when a layer of oxide is formed on the knobs, but the same layer will act as a check on the alternating discharges, thus perceptibly increasing the dynamic discharge potential.

Mechanical Theory of Electricity and Chemical Action. Whitwell. Lond. *Elec. Rev.*, Jan. 8 and 15.—An article of a theoretical nature, in which he develops the idea that probably electrical phenomena are due to molecular radiation, as suggested by Dolbear; with the aid of this theory he suggests a mechanical picture of electrostatic, electromagnetic, magnetic and chemical phenomena. His statements are criticised by Heycraft in the issue of Jan. 15.

Regulation of Röntgen-Ray Tubes. Walter. *Elek. Zeit.*, Jan. 7.—He speaks very highly of the system suggested by Dorn in which the vacuum is regulated by heating a portion of the tube containing caustic alkalies; the only objection to this method is that constant attention is necessary and there is considerable variation in the pressures; for this reason the present writer heats the portion of the tube containing the chemical, by means of a current passing through a spiral of platinum wire wound around this portion of the tube; the wire is heated from three accumulators; to avoid getting sparks the tube containing the chemical should be at the anode end of the tube, which, together with the coil of platinum wire, are connected to ground; the amount of heat generated can be regulated to a nicety by adjusting the resistance in the circuit; for small spark lengths the heat should first be a little greater than what is necessary for continuous running; in this way a Röntgen tube can be kept going continuously for any length of time at exactly the same intensity.

Röntgen Rays and Consumption. Bouchard. *Comptes Rendus*, No. 26; an Academy note reprinted in *L'Ind. Elec.*, Dec. 25, and noticed briefly in the Lond. *Elec.*, Jan. 15.—He found that the right lung of a patient threw a deeper shadow than the left and the conclusion that it was filled with tubercles was subsequently verified. In the same number Bergonie describes some striking cases in which the new method was successfully employed. *L'Ind. Elec.* also reprints an Academy note by Bouchard, on the study of pleurisy, with the aid of Röntgen rays; he concluded that a diagnosis can be made as correctly by the usual methods but the Röntgen rays could be used to advantage as an additional test; it shows at a glance the existence, the extent, and the depth of the diseased tissues.

Effect of Röntgen Rays on the Conductivity of Paraffin. Kelvin, Beattie and Smolen. Lond. *Elec. Rev.*, Jan. 15.—A brief description of a series of experiments to test whether paraffin is or is not made conduct-

ive; they find that if it is made conductive by Röntgen rays it is only to so small an extent that it is scarcely perceptible by the method which they used.

Law of Opacity to X-Rays. MARANGONI. *Atti dei Lincei*; noticed briefly in the Lond. *Elec.*, Jan. 15.—The opacity is not proportional to the density nor to the atomic weights, as the writer expected; the absorption seems to be independent of the thickne s in some cases, which suggest a mere surface action; he concludes that probably the opacities are proportional to the atomic weights when the layers are very thin.

Inductance.—Amer. Elec., January.—The principles of inductance are developed with reference to its application to broken circuits. It is shown that if L is the inductance of a coil in henrys, C the current being carried at the time of rupture, and T the time during which rupture lasts, then the mean value of the inductive E. M. F. of rupture is expressed by the formula $E = \frac{L\,C}{T}$; the maximum value however is greater than this, and occurs at the end of the rupture. It is pointed out that heated vapor from a spark continues the circuit after it is mechanically broken, which must be born in mind in giving a value to T; a conductive vapor from a spark cannot be formed; a vacuum break is extremely sharp; this fact has been utilized by Moore to obtain, with coils of extremely small inductance, inductive E. M. Fs. sufficiently high at their maxima to light vacuum tubes.

Becquerel Rays.—Elec. Eng., Jan. 20.—Illustrations of some of the results obtained by McKissick in investigating the action of all the non-phophorescent and fluorescent compounds available; he found that quite a number gave active photographic radiations after exposure to sunlight; he believes these rays to be a connecting link between ordinary light and Röntgen rays; the developments require an exceedingly long time; a very peculiar property in the radiation is that generally more than one image of an object is produced on the plate, although the object is in contact with the plate. Of all the substances tested white granulated sugar gave the best results; the photograph of two coins, a key and a piece of glass is reproduced, and was made by the radiations from sugar through a piece of wood 2.5 inches thick; in one negative he noted as many as five images of one object.

ELECTRO-CHEMISTRY AND BATTERIES.

Recent Results with the Electric Furnace.—Lond. *Elec. Rev.*, Jan. 15; a brief summary of recent results, with references to the original papers, most of which are in *Comptes Rendus*.—Moissan found that important alloys could be obtained by taking advantage of the ease with which metallic oxides are reduced by aluminum; to the fused metal is added a mixture of aluminum filings and the oxide which it is desired to alloy; a further energetic development of heat takes place which reduces the most refractory oxides. Many chemical substances when heated in the furnace gave some very astonishing results, and in some cases became transformed into minerals which up to the present time have been met with only in nature.

Making Peroxide of Lead. WARREN. Lond. *Elec. Rev.*, Jan. 15.—A note from the *Chemical News* stating that the litharge or the sulphate of lead obtained from the vitriol tanks can be changed into peroxide by first reducing to spongy lead and then peroxiding with an electric current; the former may be done by placing the material in a bag with a lead electrode connected with one of iron and emersed in sulphuric acid.

Copper Refining. KERSHAW. Lond. *Elec.*, Jan. 15.—A third installment of his serial on electricity in the chemical and metallurgical industries. After a brief history of the development of electrolytic copper refining, he discusses the question of current efficiency and energy efficiency.

Decomposition of Fused Zinc Chlorides. LORENZ. Lond. *Elec. Rev.*, Jan. 15.—A note stating that he determined the voltage required, and found it 1 49 to 1.50; the theoretical is 2.1.

Accumulator. FITZ GERALD. Lond. *Elec. Rev.*, Jan. 15.—A short criticism of the claims made for the Blot accumulator. It appears that the discharge is about 1.7 amperes per pound; the ampere-hours per pound of the whole cell is 3.6; the maximum capacity of the Kabath accumulator as published in 1883 was five ampere-hours per pound of gross weight, which is even better; the latter accumulators, however, were a failure, and he intimates that what is lacking in the Blot accumulator is durability. In the same issue it is also stated that comparing the figures for this accumulator with those of the Faure-King plates it is found that the latter have a slight advantage.

Accumulator.—Lond. *Elec. Rev.*, Jan. 15.—A translation with illustration of the description of the Guelcher accumulator which was noticed in the *Digest*, Nov. 21.

Progress in Electro-Chemistry in 1895.—Elek. Anz., Jan. 7.—The conclusion of the long serial which has been noticed before in these columns. It seems to be quite a good summary of recent progress; the present portion deals with salts, carbides and organic electro-chemistry, including reductions, oxidations and synthesis.

Recent Results with the Electrical Furnace.—El'ty, Jan. 27.—A reprint of a short article noticed above.

Calcium Carbide as a Reducing Agent. WARREN. *El'ty*, Jan. 20; reprinted from the Lond. *Chemical News*.—He refers briefly to some recent researches which have been carried out for the purpose of using this material in metallurgy as a reducing agent. With an excess of litharge, metallic lead and calcium oxide were formed; with an excess of carbide a regules of calcium and lead were formed; tin, copper and iron oxides were readily reduced, yielding results of no practical value. He believes that the partial success points conclusively toward this material as a new and powerful reducing agent for replacing sodium and potassium.

Preparation of Manganese in Electrical Furnaces. MOISSAN. *El'ty*, Jan. 20.—A reprint of a translation of a paper noticed some time ago.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measurement of Temperature. CLARK. Lond. *Elec.*, Jan. 15; a continuation of his long serial.—He discusses the question of resistance boxes and the recent improvements made in them; he discusses at some length the objections to the usual forms of boxes, showing that many of the difficulties are due to temperature changes; he concludes that platinum silver proves to be about the best material which we possess for resistance wires.

Mirror-Speaking Instrument for Use on Board Ship. RYMER-JONES. Lond. *Elec. Rev.*, Jan. 8.—An illustrated description of a system which has been adopted on certain repair steamers; the improvements consist in the method by which received signals can be varied in size, the direction of the signal can be reversed quickly, and the sensibility increased considerably beyond that of the ordinary instruments; the instrument is rendered dead-beat when worked on practically a short circuit.

Photometric Quantities. FELDMANN. *Elek. Zeit.*, Dec. 31.—A brief criticism of the discussion of this subject at the recent Geneva Congress.

Astatic Magnotometer. DU BOIS. Lond. *Elec.*, Jan 15.—An abstract of the article with the illustration which was noticed in the *Digest* last week.

Magnetograph.—Elec. Eng., Jan. 20.—A reprint of McKay's photographic impressions taken with nothing but a magnet below the plate; the originals were referred to in these columns about a year ago.

How to Make an Induction Coil. HANCHETT.—*Amer. Elec.*, January.—Directions with working drawings for making an induction coil that will discharge across a 6-inch air gap. It is stated that in the past the depth of insulation between the secondary and primary has been entirely too small, thus inducing leakage, which cuts down the power of the coil. With the type described it is said that only about one pound of secondary wire is required per inch of air gap.

Insulation of Induction Coils.—Amer. Elec., January.—It is stated that a satisfactory insulator for static coils has yet to be found; paraffin is only satisfactory owing to the great difficulty in cooling it free from air bubbles; oil is fully as objectionable, for while it is continuous and free from air bubbles, convection currents are set up in it which aid discharges; what is needed in induction-coil work is said to be an insulator that can be melted and will solidify into a dense, homogeneous mass free from all faults that will reduce its dielectric strength, and preferably a material that does not shrink away from its mould.

Measuring the Efficiency of Shunt Motors without a Dynamometer. MCKISSICK. *Amer. Elec.*, January.—The method described seems to be practically identical with the Swinburne method; it is illustrated with an example.

Measuring the Earth Current in Cable Testing. SCHOENAU. Lond. *Elec.*, Jan. 15.—When localizing a break or fault in a submarine cable it is often important to ascertain the strength of the earth or cable current; he describes briefly a method which he found convenient and quick. After the copper resistance has been measured take off the battery and note the steady deflection due to the cable current; then substitute for the cable a cell of known voltage and note the deflection through a similar resistance to that of the cable; the E. M. F. of the earth current will then be that of the known cell multiplied by the ratio of the first to the second deflections. If the cable resistance is very high then all the resistances in the branches of the Wheatstone bridge may be reduced to one tenth of their former value.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Submarine Telegraphy. MANCE. Lond. *Elec.*, Jan. 15 and *Elec. Rev.*, Jan 15.—His recent presidential address to the Institution of Electrical Engineers was devoted largely to this subject; he gives a brief history of submarine telegraphy, which is followed by a description of the state of the art in 1897; among the data which he gives is the following: There are to-day more than 1300 submarine cables in existence, aggregating 162,000 nautical miles; over half of these are less than five miles in length and eight of them exceed 2000 miles; of these 18,000 knots belong to the various governments and the balance to private companies; they represent a total expenditure of about £40,000,000 sterling, about 75 per cent. of which is English capital; up to quite recently every important cable was made in England; a fleet of 41 repair ships is maintained; the most expensive repair on record is probably one costing al-

most half a million dollars on one of the Anglo-American lines; Great Britain supplies the majority of the best telegraphers for long submarine cables; in working the land lines by the sounder the Americans are the only ones who can compare in rapidity with Englishmen; the electrician can localize the breaks in a cable closer than the captain can navigate his vessel; it is possible to transmit nearly 50 words of five letters each per minute on the Atlantic cables by an automatic transmitter.

Resistance Coils for Telephonic Experiments. Lond. *Elec. Rev.*, Jan. 8.—A brief note calling attention to the misleading results arising from the static induction in resistance coils, when used as an artificial line; the inductive capacity of a coil of two platinum wires each having a resistance of 5000 ohms, the dimensions of the bobbin being 1.25 inches in diameter and one half inch long, has a static capacity between the two wires of nearly 0.015 microfarad.

Telephone Trunk Lines. Pierart. Lond. *Elec. Rev.*, Jan. 15.—A further communication (in French) in the discussion with Gevey, see *Digest* Jan. 2, regarding shunted condensers. The telephone is not acted on by the telegraph signals through the graduators of Van Rysselberghe, on account of their self-induction; the telephone is not acted on by such signals under the same conditions when the self-induction is neutralized by a shunted condenser; he asks why this is the case.

Block Signaling. Boult. Lond. *Elec. Rev.*, Jan. 8.—A further description of his system, which was noticed in the *Digest*, Jan. 16. An editorial discussion is contained in the issue of Jan. 15.

Bureau of International Telegraphs.—Lond. *Elec.*, Jan. 15.—An article on the international bureau at Berne, Switzerland. The Lond. *Elec. Rev.*, Jan. 15, quotes from the Manchester *Guardian* criticising the impracticable methods used in connection with the vocabulary.

Auxiliary Telegraphy. Kitsee. *Jour. Frank. Inst.*, January. Reprinted in the *West. Elec.*, Jan. 23.—A short paper in which he describes a system of telegraphic apparatus which enables one to send messages through a wire which is in use for the usual telegraphic transmission; it is capable of being duplexed itself, and is of use specially on lines such as on railways, for communicating between stations without interfering with the messages sent between the end stations; the requirements of such a system are: That no batteries, generators or large resistance are to be inserted in the circuit; that the instrument be both receiving and transmitting; that the current shall not have too high a voltage, and that there will be no connection between the line and the ground; these requirements are fulfilled by this system. The sending device consists of a small alternator or mechanical interrupter in circuit with the key and the primary of a transformer, the secondary of which is connected in series with the line, while a tertiary or third coil is locally connected with a vacuum globe which acts as a visual receiver; the primary and secondary have a low, and the tertiary a high resistance; each station is also provided with a second primary connected in series with the first primary; "this second primary is placed into a coil equal in its inducing capacity to the tertiary first spoken of. The terminals of this coil . . . are connected in opposition to the first coil with the receiving vacuum tube;" this second series of coils is necessary for the duplexing of the system; a cut is given showing the connections.

American Telephone Practice. Miller. *Amer. Elec.*, January.—The theory of the battery transmitter is discussed and several of the better known forms described. The writer considers that while the property of carbon of changing its resistance under varying pressure is undoubtedly accountable for a large part of the action of the transmitter, probably an even greater factor is the variation of the area of contact between the electrodes, due to varying pressure. In regard to the argument that the microphonic action of carbon is due in part to the fact that an increase of current causes a slight heating at the point of contact, and that this heating causes a still further diminution of resistance, with an additional increase of current, it is stated that the very fact, however, that the increase of current being needed to cause the rise of temperature, seems to preclude the supposition that such rise should cause a diminution of resistance with its corresponding increase of current, in time to do any good.

Electric Interlocking System.—West. Elec., Jan. 23; taken from the *Railway Review.*—An illustrated description of a mechanism recently installed at a railroad crossing near Chicago; electric power is used without the assistance of any other power; it has been in successful operation for several months; the power is obtained from a storage battery.

MISCELLANEOUS.

Presidential Address.—Lond. *Elec.*, Jan. 15.—The beginning of a reprint in full of Mance's address to the Institution of Electrical Engineers; an abstract is begun in the Lond. *Elec. Rev.*; the first part is of local interest, and the last is noticed above under submarine telegraphy.

Biographical.—Lond. *Elec.*, Jan. 15.—A short obituary notice with portrait of Jacob Brett, who is noted for his work in telegraphy. There is also an editorial notice. The same journal contains a full-page steel portrait of Sir Henry Mance, the new president of the Institution of Electrical Engineers, together with a short biographical notice. The Lond. *Elec. Rev.*, Jan. 15, also contains an obituary notice of Brett.

Biographical. Elek. Zeit., Jan. 7.—A short biographical sketch of the late Emil du Bois Reymond.

Progress of Electrical Engineering in Germany. Lond. *Elec. Rev.*, Jan. 8.—A short note giving some statistics.

Pole-Finding Papers. Lond. *Elec. Eng.*, Jan. 15; abstracted from a French chemical journal.—The paper gives a red line, and is made as follows: 2 gr. of phenol phthalein is dissolved in 10 cb cm of alcohol, to which is added 110 cb cm of distilled water, making a milky emulsion; 20 gr. of sulphate of soda are dissolved in 100 of water; after the sheets have been dipped in the first solution and while still damp, they are immersed in the second; after being dried the paper is extremely sensitive to the action of the electrical current.

Electric Welding. Walker. Lond. *Elec. Eng.*, Jan. 8.—A reprint of a recent paper describing in a general way the Thomson, the Zerener and the Benardos processes, but giving nothing new.

Electrization of the Stomach. Einhorn. *Elec. Jour.*, Jan. 1.—An article giving a report of a number of tests made to determine the effects of direct electrization of the stomachs of animals, from which it appears that in certain animals Faradic currents produce contractions of the stomach under certain conditions.

Electrical Progress in 1896. Armstrong. *West. Elec.*, Jan. 9.—A reprint of an article from the Chicago *Record*, relating chiefly to the year's doings in Chicago and the West, but including a survey of the whole electrical field.

Patents and Electrical Inventions. Townsend. *Elec. Eng.*, Jan. 6.—A short article of a general character on electrical patents and inventions during the past 20 years.

Electricity in Naval Life. Fiske. *Elec. Eng.*, Jan. 13.—An illustrated description of his horizontal base position finder.

Electricity in South America.—West. Elec., Jan. 16.—A reprint article noticed in the *Digest*, Jan. 16.

Developing a High Vocal Register by Electricity. King. *El'ty*, Jan. 20.—The first part of a reprint of a paper read before the National Society of Electro-Therapeutists, in which he intends to illustrate the action of the electrical current through the two nerves, in developing the muscles supplied by them; the present portion is introductory.

Metric System in Electrical Industries. Hickok. *Electricity*, Jan. 20.—The first portion of a reprint of a paper read before the Chicago Electrical Association; the present portion is chiefly historical.

Observations on Magnetized Watches. Lewis. *Jour. Frank. Inst.*, January.—A reprint of a recent paper, in which he discusses the subject in a general way and describes with the aid of illustrations an apparatus which he has designed for demagnetizing watches; it consists essentially of a very large, short solenoid, and a table which can be moved in the direction of the axis; the watch is mounted on this table on a stand which, with the aid of an electric motor, revolves the watch around a horizontal axis and at the same time around a vertical axis, so that all parts of the watch are brought into all possible positions; this is to overcome the objections to the ordinary helix used for the purpose, but with which there is one direction in which the watch is not demagnetized; there are no demagnetizers at present in use which thoroughly demagnetize all parts of a watch unless it is taken apart, each piece being submitted separately and afterwards examined. Photographs of magnetized hairsprings are shown.

Incandescent Lamps vs. Commercial Heaters. Porter and Warner, *Elec. Eng.*, Jan. 20.—An article describing and giving the results of some comparative tests, one of which was made with a commercial heater, and the other with a batch of incandescent lamps, each consuming about 3.5 horse-power; the heater, or bank of lamps, was placed in a sort of box, and the rise of temperature in the room was measured for several hours; the various quantities measured are given in the form of curves and tables; a comparison of these shows that with the lamps the temperature rose more quickly than with the heater, and there is a more even distribution of the heat throughout the room; the lamps also had a smaller heat capacity. The room contained 1396 cubic feet; the mean watts consumed were 2883, the time was two hours and forty minutes, and the increase of temperature 16.55 degrees C.

Biographical. West. Elec., Jan. 23.—A short biography, with portrait, of John A. Roch, of Chicago.

New Books.

National Electrical Code. An Analysis and Explanation of the Underwriters' Electrical Code, Intelligible to Non-Experts. By Pierce & Richardson. Charles A. Hewitt, Chicago. 222 pages. Price, $2.

The stated purpose of this work is to explain the Underwriters' electrical code in ordinary language, for the benefit of insurance inspectors and electrical students who are not familiar with the electrical terms.

Most writers on electrical topics, the authors assert, confuse the non-expert by their continued use of technical terms, and it is for the benefit of this class that the efforts represented in this book have been put forth. The electrical code has come to be looked upon by all interested as a safe guide and instructor in wiring, and it is important therefore that a wider knowledge of its rules and provisions should be promoted. The object of the authors being a worthy one, and since they have performed their part of the plan in an admirable manner, their efforts are entitled to the hearty support of those they are reaching after. They have, to say the least, succeeded in clothing the standard rules in more interesting language, and this fact alone will have great weight, particularly with those for whom the work is especially designed.

THE A B C OF THE X-RAYS. By William H. Meadowcroft. New York: The American Technical Book Company; 184 pages; 37 illustrations. Price, cloth, 75 cents; paper, 50 cents.

In producing this work Mr. Meadowcroft addresses two classes of readers—the one comprising those who wish to add to their stock of general information, the other those who wish to experiment in Röntgen-ray work—and the author certainly has presented his subject in a manner that will greatly assist both classes. Mr. Meadowcroft gives in simple English a practical explanation of apparatus and methods employed in producing and applying Röntgen rays, beginning at the very foundation of the laws involved. After describing the apparatus necessary to excite the Crookes tube, the author gives a brief reference to the fundamental laws of induction in order to lead the reader to a better understanding of the general subject. The induction coil receives careful consideration, and its construction is so clearly described that almost any one should be able to build a satisfactory instrument from the directions given. Like treatment is accorded the other pieces of apparatus that form an essential part of a Röntgen-ray outfit.

The scope of the work will probably be better appreciated by the enumeration of the chapter headings, as follows: I, Introduction; II, The Exciting Apparatus; III, Induction; IV, Induction Coils; V, Contact Breakers; VI, The Condenser; VII, High Frequency Apparatus; VIII, Static Machines; IX, The Crookes Tube; X, The Fluoroscope; XI, The Source of Current; XII, Manipulation; XIII, Practical Suggestions; XIV, Photographic Plates and Developers. Every subject is completely and concisely discussed, and taking the work all in all it will no doubt meet a popular demand for information on this interesting subject. The book is well illustrated with reproductions of radiographs, diagrams and views of the various devices used in a complete Röntgen-ray outfit. Röntgen-ray experimentation is a line of work that is constantly unfolding new facts, but Mr. Meadowcroft has succeeded very well in presenting the best and latest practice in this exceedingly interesting field, and brings the subject up to date.

Temporary Electrical Work in Unfinished Buildings.

Temporary electric lighting installations have proven to be an almost indispensable aid during the construction of the modern many-storied buildings. With such artificial illumination, work is carried on throughout the entire 24 hours with many resulting economies. It is interesting to note that in almost every case when current can be obtained from the street electric supply service, or sometimes from adjacent isolated plants, both arc and incandescent lights, and in some cases electric motors, are temporarily used. As the building progresses temporary wiring is extended from floor to floor, and in some cases supplies quite a large number of lights.

A number of New York "sky scrapers" now in course of construction are wired for from 50 to 100 arc lamps and 200 to 300 incandescents. In one of these building a pipe cutter and a drill press are being operated by electric motors and in another several electric tile polishing machines are in use. Other applications will readily suggest themselves. Originally the wiring is usually in a fairly good condition, but as the work on the building progresses, constant overhauling and changing is necessary. One or more men are continually employed in watching the work and making the alterations in the location of the lights.

In the present temporary installations of this nature ordinary single and twin rubber insulated conductors are used supported on porcelain insulators fastened to the iron and brick-work. In some cases lead-armored conductors are used without insulators. It would seem advisable to adopt some special conductors and fittings for this work. There also seems to be an excellent field here for compact, portable electric generating plants, consisting of vertical boiler, high-speed engine, and direct-connected dynamo mounted on a single bed-plate or separately. The use of such portable plants would certainly be productive of particularly economical results. A compact gas engine and dynamo combination on the same lines might also be suggested if the necessary continuous running could be guaranteed.

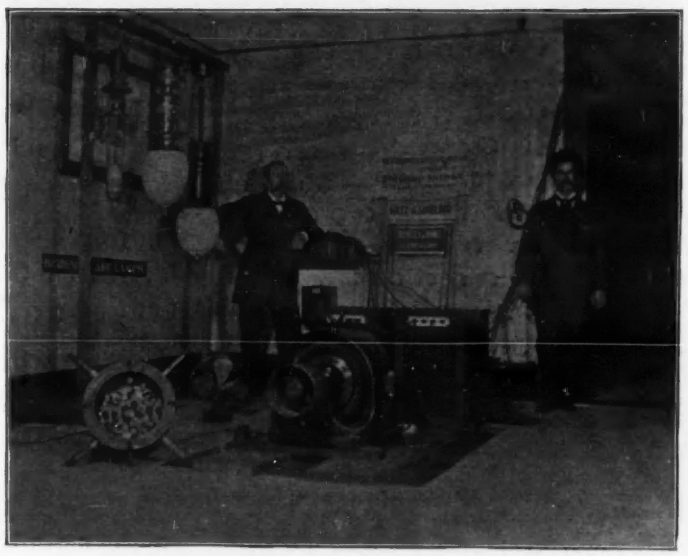
Aside from the importance of proper illumination and power appliances, the necessity for frequent intercommunication between distant parts of these 15 to 25 story buildings, would seem to warrant the installation of a temporary telephone system with stations perhaps on each floor. The temporary installation of such systems is to be expected in future large buildings during construction.

Underground Feeder Junction Box.

With the advent of the high-tension alternating-current underground system the apparent necessity for an improved method of making connections to the feeders in the manholes has been evident.

Wiped joints gave good satisfaction, and high insulation when well done, but they made the testing for insulation almost impossible, except upon a whole system connected to each feeder. When the insulation was low on a feeder, the location of a fault necessitated the cutting of a number of joints in order to divide the cable into sections; this together with the time consumed in renewing the joints, caused the whole section fed by that feeder to remain in darkness for a considerable time. It was evident therefore that some method was urgently required by which a permanent and high-insulation connection could be made, and at the same time allow easy access to the ends of the cables for cutting out and testing.

This necessity has been met in a very successful manner by Mr. Jacob Cloos, electrical engineer of the Pabst Heat & Light Power Company, Milwaukee, Wis., by the use of a junction box, which has been in successful operation for some time on a 2400-volt underground system at the company's plant. This box, shown at the left of the accompanying illustration, consists of a cast iron-box of cylindrical section. The top of the box is made water tight by means of a lead gasket and holding-down screws. The feeder and mains are led into the box through brass bushings, screwed in with a lead gasket, the lead cover of the table being joined in the bushing with a wiped joint. Within the box are two marble



FEEDER JUNCTION BOX SHOWN AT THE LEFT.

plates about three inches apart. Upon the top plate are mounted brass terminals arranged in three concentric rows for three wire cables, connected by special terminals and fuses to the various cables. Upon the lower plate are three continuous brass rings, directly under the brass terminals on the upper plate. The lower rings are made alive by pushing spring plugs through holes in the terminals connected to the feeder into holes in the rings directly below on the lower plate, any cable being thus connected to the feeder. The boxes are filled with oil, thus forming a water-proof joint of high insulation and one easily accessible.

These boxes have been in use when covered with water, and no difficulty has been experienced. They have demonstrated their value on several occasions by facilitating repairs and locating faults on sections, without interfering in any manner with the operation of the rest of the system.

Forty Years of Light.

The firm of I. P. Frink, 551 Pearl Street, New York, has for 40 consecutive years jealously guarded its reputation for fair dealing and the superior quality and construction of its reflectors.

Successful from the start, it has kept far in the lead, keeping pace with this age of light, improving quality and construction, so that the 1897 could hardly be recognized as a distant relative of the 1857 reflector. During this time the firm has lighted over 20,000 churches, covering nearly every country in the world, and thousands of halls, theatres, armories, schools, hospitals, court houses, stores and public buildings, receiving first prize, medal and diploma at the World's Fair, Chicago, in 1893.

From Lagos, West Africa, the firm has received orders for lighting several groups of buildings for the Church Missionary Society of London, England, and has just received another order from there for lighting another group of buildings, accompanied by a draft on the London Society for £75 sterling, an amount that some of our more pretentious home churches hesitate to expend on lighting fixtures.

The firm has now in hand the lighting of the buildings of the new Corcoran Art Gallery, Washington, D. C., the Rhode Island School of De-

sign, Providence, R. I., and of churches in nearly every State in the Union.

During the holidays they received several orders by telegraph giving the size of the churches, with no previous correspondence. These few straw clearly indicate the esteem in which the firm is held by the general public.

Their facilities for turning out good work promptly are more perfect than ever before. They invite correspondence on the subject of material light, and send Book of Light free on request.

Echoes of the Milwaukee Convention.

The fifth convention of the Northwestern Electrical Association is now a past event, but there are many pleasant lingering memories in the minds of those who were there. Mental pictures are, however, apt to lose some of their freshness in the lapse of time, and their details are liable to fade away from the memory, but in this instance a Milwaukee photographer has come to the rescue and recorded, for the edification of those interested, a more substantial picture of some of the principal things that were to be seen at the Convention.

The familiar features of those who contributed by their presence, voice and other influence to the success of the meeting are shown in one of the accompanying illustrations. The other three illustrations represent prominent exhibits at the hotel.

GROUP VIEW OF ATTENDANTS AT THE MILWAUKEE CONVENTION.

EXHIBIT OF STROMBERG-CARLSON TELEPHONE MANUFACTURING CO.

THE EXHIBIT of the Stromberg-Carlson Telephone Manufacturing Company, Chicago, included samples of that company's various styles of instruments, the illustration showing the same in a clear manner. Two complete wall sets are shown, also receivers, magnetos, desk switch, desk sets, all complete ready for use. An important feature of the transmitter is that it must be turned before it can be used. This necessary act results in preventing the packing of the carbon, thus maintaining the instrument at its highest efficiency. The company has installed exchanges in several places in the West and South.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, St. Louis, occupied parlors 10, 11 and 12, and made an exhibit which was quite fully described in last week's issue of THE ELECTRICAL WORLD. The various samples of apparatus there described were displayed on the large table as shown in the illustration, the Wagner transformer at the right hand being one of

EXHIBIT OF THE WAGNER ELECIRIC MANUFACTURING COMPANY.

the most conspicuous features of the exhibit. The single-phase alternating-current ceiling-fan motor, which also attracted much attention, forms a conspicuous object in the picture.

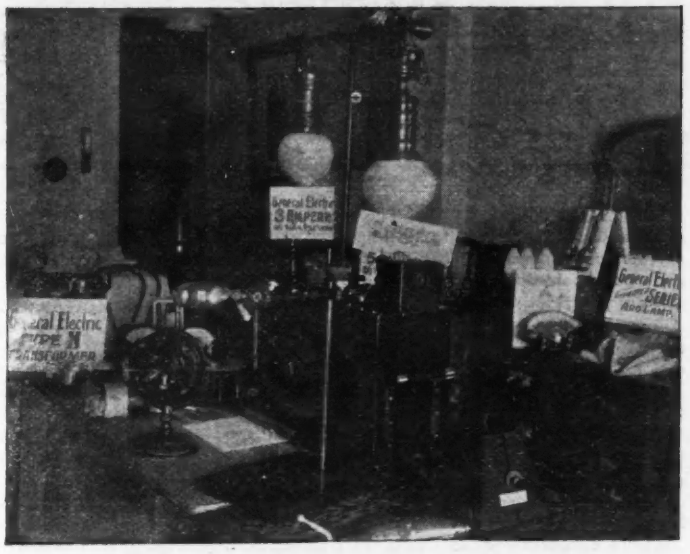


EXHIBIT OF THE GENERAL ELECTRIC COMPANY.

THE GENERAL ELECTRIC COMPANY'S exhibit of Röntgen-ray apparatus, lightning arresters and arc lamps, which was also described in the last issue of THE ELECTRICAL WORLD, forms the subject of one of the illustrations herewith. All of the devices are shown prominently in the picture, and the exhibit was one of the greatest attractions of the convention.

Electric Power in a Nut and Bolt Factory.

Although the transmission of power outside the limits of Niagara Falls is not yet a month old, a large nut and bolt works at North Tonawanda has, for the past year, been waiting fully equipped for the appearance of the current. These works, the largest nut and bolt factory in the country, are those of Messrs. Plumb, Berdict & Bernard.

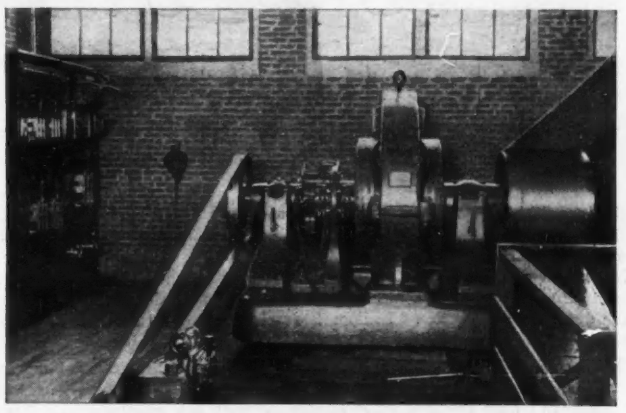
Until Niagara power can be obtained the works are being operated from their own generating station, which will be abandoned as soon as the Niagara Power Company is ready to tap the three-phase lines into the factory. The generating station is set between the cold and machine shops. Steam from the engine is supplied by three Riter Bros. return tubular boilers, each of 100-hp capacity. The engine is an improved Green of 400 horse-power belted to a General Electric three-phase six pole 150-kw, 25-cycle, 500 r. p. m. generator. The exciter is a 3-kw, 125 volt bipolar machine. The switchboard is of panel type, built up of two panels, one for the generator and the other for the feeders. The generator panel carries potential indicator, two current indicators, field switch, main switch and two Carpenter enamel rheostats. The feeder board in addition to the fuses is equipped with four three-blade knife switches, each controlling one circuit and labeled "Cold Press," "Machine Shop," "Thread Shop," "Forge Shop," respectively.

The forge shop, which is 360 feet long, contains five 20-hp General Electric induction motors, four driving the shafting and one operating a blower. The shafting is divided into four sections, and each one is belted to one of the induction motors.

The driving motors themselves are set upon a platform above the shafting in the centre of the shop, and are boxed in. The blower motor directly connected to the blower occupies a platform at the south end of the shop. The machinery driven by the motors in the forge shop are different sizes of bolt headers and nut punchers and shearing machines for shearing the bolt lengths from the rod.

In the cold shop the pointing department is operated by one 20-hp motor, set on the floor and belted to jack-shafts and counter-shafts as necessary.

In the machine shop, lying on the south side of the engine room, is another 20-hp motor, also set upon the floor. It is used to drive a



ELECTRIC POWER GENERATING PLANT.

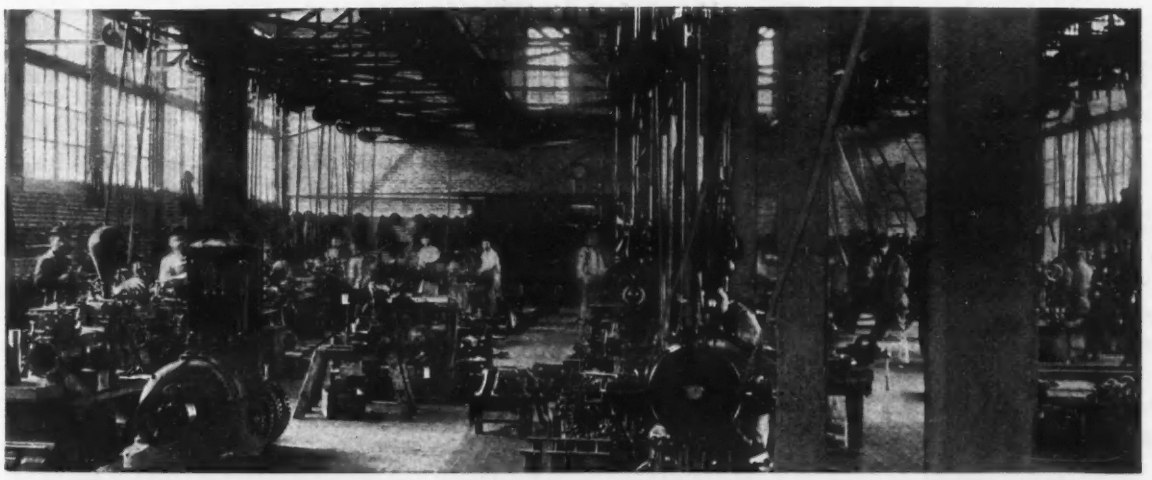
variety of tool-making machinery, such as planers, milling machines, drills, slotters, shapers, etc.

The threading and finishing shop, 400 feet long, is next in length to the cold shop, which is 430 feet in length. In it the bolts and nuts traveling from the other shops are threaded and tapped, and put together ready for the market.

This shop is driven by six 6-hp motors set on small platforms, and three 20-hp motors. The smaller motors and one 20-hp motor are used to drive the automatic and semi-automatic threading and tapping machines. For the former they are belted to jack shafts from which belts are dropped to pulleys on a shaft running underneath the machinery. For the semi-automatic machinery, the pulley is on the level of the machines and is belted to the jack shaft above.

The other 20-hp motors are set on the floor and are belted to shafting on the opposite sides of the shop as shown in the illustration. These serve to drive the heavy threading and tapping work not automatic, and some idea of the variety of the machinery in these shops, and the work the motors are called upon to do, may be gathered from the fact that the sizes of bolts made run from $\frac{3}{16}$ inch up to $1\frac{1}{2}$ inch.

The advantages of electric drive are markedly noticeable in this plant. There are no separate engines for the individual shops, and no belt holes in the walls, as would have been the case had the steam driving plant been confined to an outside building. The wires come through three small porcelain-bushed holes in the wall of each shop. The central steam and generating station is confined to one room at present, and will probably shortly be entirely abolished. The motors in the forge shop occupy no space on the floor of the shop, and those in the other shops occupy either small space upon the floor or are erected on small platforms. They require no attention beyond the filling of oil wells, which is performed but once in six months. They are started by the throwing of a switch, and maintain a steady and constant speed under all conditions of load. This is noticeable in the quality of the output.



VIEW OF SHOP SHOWING INDUCTION MOTOR.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Jan. 27, 1897.

ELECTRICAL STOCK.—There was a much stronger feeling in this list, the closing prices being with two exceptions higher than at the close of last report. The advances, however, were fractional, but there were numerous enough to indicate a general better feeling. The two exceptions were Edison Electric Illuminating of New York, and Westinghouse Consolidated preferred, each of which declined a fraction. Edison Electric and General Electric bonds advanced several points each.

TELEGRAPH AND TELEPHONE.—Quietness prevails in this list of securities, the general market being about steady. Bell Telephone is unchanged, and Western Union receded ⅝, as compared with last quotations. Commercial Cable also declined, closing with a loss of 2 points. The only advance recorded is in Erie Telephone, which closed at a figure 1½ points higher than last week's quotation.

ELECTRIC TRACTION.—Great quiet prevailed in the traction list at the time of making up our quotations, many of the shares being unchanged in price. What few changes are recorded are generally downward, with the single exception of North Shore Traction, which closed at an advance of 2 points in the asked price. Electric railway bonds remain unchanged in price.

DIVIDEND.—The directors of the New England Telephone & Telegraph Company have declared a regular quarterly dividend of $1.25 per share, payable Feb. 15.

MORTGAGE.—The Thirty-fourth Street Railway Company, New York City, for which the Metropolitan Street Railway Company acts as guarantor, has placed a mortgage for $1,000,000 on its property, privileges, rights and franchises. The Central Trust Company holds the mortgage.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	110	..
Edison Electric Ill., New York	100	103¾	105
" " " Brooklyn	100	88	93
" " " Boston	100	..	..
" " " Philadelphia	100	..	..
Edison Ore Milling	100	7½	10
Electric Storage Co., Philadelphia	100	23⅜	30½
Electric Storage, pref	100	32⅜	32½
General Electric	100	34⅝	34¾
General Electric, pref	100	77	79
Westinghouse Consolidated, com	50	23	25
" " pref	50	50	51

BONDS.

Edison Electric Ill., New York	105	111¼	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	95⅛	—

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	212	213
American District Telegraph	100	*29	39
American Telegraph & Cable	100	85	90
Central & South American Telegraph	100	124	127
Commercial Cables	100	158	172
Erie Telephone	100	66¼	66½
New England Telephone	100	102	..
Postal Telegraph-Cable	100	91	94
Western Union Telegraph	100	84	84¼

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	17¼	17⅜
Brooklyn Rapid Transit		18	20
Brooklyn Traction	100	..	14
" " pref	100	46	48
Buffalo St. Ry	100	73	75
Cleveland Electric Ry	100	..	..
Columbus St. Ry	100	39	42
Hestonville	100	50½	51
" pref		..	62½
New Orleans Traction	100	..	11
" " pref	100	..	45
North Shore Traction	100	21	24
" " pref	100	74	78
Rochester St. Ry	..	..	20
Steinway Ry	..	45	50
Union Railway (Huckleberry)		98	103
Union Traction, rcts $10 pd	..	12¾	13
West End, Boston	100	64	65
" " pref	100	89	90
Worcester Traction	100	20	22
" " pref	100	95	98

BONDS.

Brooklyn Rapid Transit 5s. 1945	100	78⅜	..
Buffalo St. Ry. 1st con. 5s	100	*107	110
Cleveland Elec. Ry. 1st mtge 5s	100	102	104
*Columbus St. Ry. 1st 5s	100	94	96
Rochester St. Ry. 1st 5s	100	..	100
Union Railway (Huckleberry) 1st mtge 5s		*101	104
*Westchester Electric 1st mtge 5s	1st	100	103

* With accrued interest.

INCREASE OF CAPITAL.—The Southwestern Telegraph & Telephone Company, of New York City, on Jan 22, has filed with the Secretary of State a certificate of increase of capital stock from $3,000,000 to $4,000,000. The company has a paid-up capital of $3 000,000.

NEW ISSUE OF STOCKS AND BONDS LISTED ON THE EXCHANGE.—Among the securities listed on the New York Stock Exchange on Jan. 27 were the following: The Edison Electric Illuminating Company of Brooklyn, additional capital stock, $250,000, making a total amount listed of $4,000,000, and an additional issue of first mortgage 5 per cent. gold bonds of $250,000, making the total amount listed $1,250,000.

EDISON EARNINGS.—The report of the Edison Electric Illuminating Company of New York, shows the gross earnings for December to be $246,275.78, an increase of $32,158.08, as compared with the same period in 1895; net earnings, $133,118.60, an increase of $22,794.64. The gross earnings for the year ending December were $2,247,437.83, an increase of $246,581.90 over 1895; net earnings for the year, less depreciation, $960,156.94, an increase of $124,476.11.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, Jan. 27, 1897.

MR. A. L. DOREMUS has been appointed secretary of the Crocker-Wheeler Electric Company.

THE HENRY ELECTRICAL SOCIETY.—Mr. F G. Sever, of Columbia University, will talk before the Henry Electrical Society on Feb 5 on the measurement of losses in small dynamos and motors. The lecture will be almost entirely experimental, tests being made before the audience.

MESSRS. C. C. SIBLEY & CO., 329 Fourth Avenue, have dissolved partnership. The company was composed of Clarence C. Sibley and T. M. R. Meikleham and dealt extensively in electric light and railway supplies. Mr. Meikleham has purchased Mr. Sibley's interest, and will henceforth continue the business under his own name.

ELEVATOR ACCIDENT.—A freight elevator at the factory of the Interior Conduit & Insulation Company, 527 West Thirty-fourth Street, this city, on Jan. 26 fell five stories, resulting in the injury of five men who were on the elevator platform. The accident, it is stated, was caused by a defective ratchet. One of the men was so severely injured that it was thought he would die.

THE PHŒNIX INTERIOR TELEPHONE COMPANY, this city, has moved its office and factory at 163 and 168 Greenwich Street, to the five-story building, 93 Washington Street. This change was rendered necessary on account of the rapidly increasing business of this young firm, which increase is extraordinary when it is remembered that just about two years ago the company commenced business with one foot lathe and one man.

THE METROPOLITAN COMPANY'S NEW ELECTRIC ROADS.—It is stated that the General Electric Company and the Metropolitan Traction Company have signed contracts for the electric equipment for the Fourth, Sixth and Eighth Avenue railway lines. The generators will aggregate 18,000 horse-power, which will be sufficient to move 500 cars. The General Electric Company, it is stated, will at once supply the motors and other electrical equipment for 250 cars. The John Stephenson Company will build a large number of the new cars.

THE ELECTRICAL MAINTENANCE COMPANY, 50 Broadway, this city, has recently effected a consolidation with the Dynamo-Electric Maintenance Company, and business will be carried on under the name of the former corporation. The company starts out with an unusually bright prospect, having nearly 1000 maintenance contracts on hand in New York, Boston and Philadelphia. The president of the new company is E. R. Johnes; vice president, John F. Merrill; secretary, Leon Abbett; treasurer, George Harvey Cook. The general office of the company is at the address above given.

THE SECOND AVENUE RAILWAY IN NEW HANDS.—The Metropolitan Traction Company, New York, has secured a controlling interest in the Second Avenue Railway by the purchase of the necessary amount of stock. The stock was bought by Mr. W. C. Whitney, with the ultimate purpose, it is thought, of bringing about an incorporation of the Second Avenue line with the Metropolitan Company's system. The Second Avenue Railway Company has been in operation since 1854 by horse-power. It is reported as likely, that under the new order of things, the horses will be displaced in favor of electric traction on the underground conduit system.

FORD, BACON & DAVIS is a new firm of engineers in this city, but its members are all well known in the electrical field. Messrs. Frank R. Ford and George W. Bacon, formerly composing the firm of Ford & Bacon, have associated with them Mr. George H. Davis, whose wide experience and ability is generally recognized. There can be no doubt that with this addition the new firm will increase the already high reputation it has secured through its me-

chanical skill and energetic business methods. Its offices will hereafter be located in the St. Paul Building, New York, the Philadelphia Bank Building in that city, and the Morris Building in New Orleans.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., Jan. 27, 1897.

MORE POWER WANTED.—The Acetylene Light, Heat & Power Company, Niagara Falls, has made a contract with the Niagara Falls Power Company for 4000 additional electrical horse-power.

THE BUFFALO PUMPING STATION is to have a complete electric light plant. It is estimated that the plant will cost about $10,000, and the installation of the same is in charge of the board of public works.

THE BUFFALO RAILWAY COMPANY.--Manager H. H. Littell of the Buffalo Railway Company has about concluded to remove the shops now at Cold Springs to Military Road at Hertel Avenue, and has purchased between 400 and 500 feet of land in that vicinity. This will be a desirable location for the repair shops, as it is near the Erie, Central and Lackawanna railroads and is in close proximity to the power lines from the Falls.

NO MORE ANCHOR ICE.—There will be no more trouble for the Niagara Falls Power Company by reason of anchor ice, for the new ice rack is now in position. It is constructed of iron, and is 300 feet long, with 15-feet bars placed an inch apart; the rack extends from penstock No. 1 to penstock No. 7, which increases the area four times. The old arrangement consisted of a more or less imperfect rack for each inlet. The officials of the company state confidently that there will be no more "anchor ice shut down."

OPPOSITION TO AN EXTENSION OF TIME.—A strong effort is being made by the Canadian municipalities in the Niagara peninsular to have the Ontario Government refuse an extension of time to the Canadian Niagara Power Company in the development of electrical power on the Canadian side of the river at the Horseshoe Falls and within the Queen Victoria Niagara Falls Park. The Canadian Niagara Power Company has paid an annual rental of $25,000 a year for the past seven years for the exclusive privilege of developing power within the park. Nearly every city, town, village, country and township council along the border has adopted strong resolutions protesting against an extension of time.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, MASS., Jan. 27, 1897.

THE ANCHOR ELECTRIC COMPANY, Boston, always circulates to the trade neat and tastefully printed matter, and its calendar for 1897 is a decidedly neat production. The frontispiece represents the company's trade mark—an anchor—the rope attached to which encircles the calendar in the form of a border, looping tastefully its switch and other specialties.

THE BOSTON RAPID TRANSIT COMMISSION.—The second annual report of the Boston Rapid Transit Commission, for the year ending August 15, 1896, has been issued It is produced in book form and contains 84 pages and includes a large number of diagrams, plans, etc, showing the progress of the work. Several very fine photogravures illustrate the various features of the work of subway construction, and the report is very complete in details.

MR. E. W. BURDETT, of Boston, has been retained by the West End Street Railway Company as its general counsel in all legislative matters affecting its interests before the Massachusetts Legislature. Mr. Burdett is well and favorably known to the electrical interests generally, and has been, since its organization, the counsel of the Massachusetts Electric Lighting Association. He has done most effective work in preventing legislation antagonistic to electrical interests.

THE COLUMBIA ELECTRIC COMPANY, Worcester, Mass., has been awarded the electric lighting contracts of the West Side and East Side high schools and Broad Street Grammar School, in Providence, R. I. The installations will embrace an aggregate of about 2000 lights. The iron-armored conduit of the Interior Conduit & Insulation Company, New York, will be installed in the school buildings. This contract is quite a victory for the Columbia Company, in view of the fact that competition was sharp.

THE AMERICAN STEAM GAUGE COMPANY, 34-38 Chardon Street, Boston, has just issued a very neat catalogue of 144 pages describing the Bourdon steam gauge and other steam devices and apparatus manufactured by this company. The catalogue is very finely illustrated, and the prices of the various goods are revised up to date. All interested in the generation of steam and the uses of the same will no doubt find much interest in the contents of this catalogue. This business was established in 1851 and incorporated in 1854. Among the products are the American Thomson steam engine indicator, Amsler's polar planimeters, American pop safety valves, water relief valves, revolution counters, whistles, water gauges, hydrometers, etc.

WHITMAN & COUCH, who have succeeded the firm of Williams, Couch & Whitman, of 196 Summer Street, Boston, will continue to represent the Ericsson Swedish telephone, which will be pushed with even greater energy. Mr. Whitman and Mr. Couch are both young men of excellent business and technical knowledge, are indefatigable workers, and will unquestionably increase the somewhat enviable record this firm has already made for the Ericsson Swedish telephones Among the various important installations so far contracted for are the following: Pratt & Whitney Manufacturing Company, Pope Manufacturing Company, Hartford Cycle Company, Hartford, Conn.; Mossberg Granville Manufacturing Company, Providence, R. I.; West Warren Cotton Mills, West Warren, Mass.; Malden (Mass.) High School; Danvers (Mass.) Insane Asylum and Howe Shoe Company, Marlboro, Mass. The firm has also been successful in getting the Boston & Maine and Fitchburg Railroad Companies to adopt exclusively (outside of extra long-distance work) the Ericsson telephone system. Whitman & Couch are sole selling agents for the United States of the Swedish coal grain microphone.

WESTERN NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, ILL., Jan. 26, 1897.

THE METROPOLITAN ELECTRIC COMPANY reports that its stock was slightly damaged from the large fire which occurred in the adjoining buildings on the night of Jan. 26. The fire did not reach the stock, and what little damage it received was from water. The company is now operating its full force.

THE ELKHART TELEPHONE COMPANY, Elkhart, Ind., at the first of the year sent out to its patrons, with its compliments, a neat little card bearing the pictures of two little children using a telephone line. The card contains some business references which apply to the company's interests. It was a bright idea and no doubt was appreciated by its patrons.

MR. JAMES F. CUMMINGS, of the Armorite Interior Conduit Company, Detroit, Mich., travels probably more than any other man connected with the electrical business. In 1896 he covered 43,000 miles. Mr. Cummings this week secured through Messrs. Vallee Bros. & Co., Philadelphia agents, a contract for 50,000 feet of tubing for the new Girard Building in that city.

MR. H. E. WALTER, 710 Clark Street, Evanston, Ill., has a system of police andfire alarm telegraph which he is now exploiting. This system is claimed to be absolutely non-interfering, cheap and reliable, and is operated on the open-ircuit principle. The fire alarm and police signal system are completely developed. Mr. Walter is the inventor, and is now looking for capital to enable him to put the system on a commercial basis. It embraces several unique features, and should be investigated by all having an interest in such matters.

MR. JAMES E. KEELYN and Mr. J. G. Nolen, Jr, of the Western Telephone Construction Company, have recently returned from a business trip with broad smiles on their faces. The cause of their good feeling is that they have just succeeded in closing what is probably the largest single contract for telephones ever made. This contract includes 10,000 telephones and switchboards with a capacity of 10,000 subscribers, together with all requisite appurtenances. The company has just filled a contract at Norfolk, Va., for a 1200-capacity switchboard; and also one in South Carolina for a 500-capacity switchboards and 500 telephones. The company has just made arrangements to double its manufacturing plant in size and capacity in order to meet the increasing demand for its apparatus.

MOTORS DIRECT CONNECTED TO PRINTING PRESSES.—The Germania Printing Company, Milwaukee, Wis., one of the largest printing establishments in the West, has recently completed a large and substantial eight story stone and brick building for the accomodation of its extensive business. Electric drive was adopted for all presses and machines. The contract for the equipment of electric motors was awarded to the Northern Electrical Manufacturing Company, Madison, Wis., for its "Northern" spherical invertible steel motors, a motor being directly connected to each separately driven machine. The engineer in charge of this building, Mr. A. M Patitz, has undertaken to carry out the most complete electrical equipment possible consistent with excellence in design and efficiency of all machines. The two upper stories and the basement of the building are taken up with the bookbinding machines, presses and typesetting machines, each direct connected to a "Northern" motor. The intermediate floors are occupied entirely by offices in suites and single apartments, to suit various requirements, all furnished with every modern convenience. Few if any concerns in the West have better facilities than the Northern Electrical Manufacturing Company for the manufacture of direct connected motors. Its shops are modern and fully equipped with the latest and best tools, and the concern is energetic and has plenty of capital to back it. A large measure of business is assured the company.

ST. LOUIS NOTES.

ST. LOUIS, Jan. 19, 1897.

NEW OFFICER.—Harry A. Coit has been elected assistant secretary of the Missouri Telephone Manufacturing Company, of this city. He is also manager of the sales department.

THE WAGNER ELECTRIC MANUFACTURING COMPANY.—The following officers were recently elected by the Wagner Electric Manufacturing Company: S. M. Dodd, president; Jas. W. Beel, vice-president; S. B. Pike, secretary and treasurer. The above gentlemen, with H. A. Wagner and Fred Schwerat Mann, compose the Board of Directors.

THE MISSOURI TELEPHONE MANUFACTURING COMPANY has about completed the longest system of cross-country toll line in the country. It extends from Briggs' Landing, on the Mississippi River, to Cascade, in the eastern part of Tennessee, nearly across the State, a distance of nearly 700 miles. There are 90 telephones in the system, all long distance toll-line instruments.

WELL-DESERVED PROMOTION.—George Rex, who has been connected with the home office of the Columbia Incandescent Lamp Company, St. Louis, for several years, will leave in a few days to take the management of the Chicago office of the company, Room 1236, Monadnock Building. Mr. Rex has held a responsible position with the company here, and his promotion is a well-deserved one to a young man who has done faithful work and made an excellent record.

THE CONDUIT PROBLEM.—The Board of Public Improvements has sent out to the applicants for conduit space a letter asking: 1. "How many ducts they require for their individual needs for telegraph or telephone purposes, and the internal diameter of each. 2. How many ducts for electric light or power purposes, and internal diameter of each." It is the opinion that each company has asked for more space than is actually needed, in the hope that some day it may be permitted to rent space to other companies.

THE KINLOCH TELEPHONE COMPANY has already secured nearly 1000 subscribers. After four days of soliciting, 972 contracts were signed; 701 are for telephones in business establishments, 192 in residences and 79 in physi-

cians' offices. Of the 972 subscribers, 584 were patrons of the Bell Telephone Company. The Kinloch Company's service will be cheaper than that of the Bell Telephone Company, and the competition will probably end in one way. The Bell Telephone Company will no doubt rebuild its exchanges, and that means that it will raise their prices, as it has generally in other cities when the systems have been rebuilt.

THREE SIDED.—About three years ago the Home Telephone Company which was thought to be defunct, was organized, and announced that it would fight the Bell Telephone Company by offering superior inducements. Solicitors were sent out and several thousand five-year contracts secured. These contracts are still in force, the company claims. The company now announces that it is going to compete with the Kinloch and Bell Telephone Companies. The president, Mr. W. J. Atkinson, is reported to have written Mr. Charles Green, president of the Peoples' and Fourth & Arsenal Street Railway, that he would enter into negotiations for the lease of all or a part of the conduit space of the company. This triangular war will make the war both interesting and profitable to the citizens of St. Louis.

MATERIAL FOR CONDUITS.—The Board of Public Improvements sat as a Committee of the Whole last week to consider the conduit situation, and the applications of the various companies for space in the streets have been partially examined, and it was found that in numerous instances they want more space than the streets will afford, especially in downtown streets. Another matter that worries the committee is that each company wants to use different material in constructing its subways. Most of the companies prefer vitrified clay; but the Western Union wants to lay its wires in iron pipe. If iron is used, the committee seem to think that the metal will not last, as samples of iron and lead pipe gathered by the Supervisor of City Lighting, show that they are gradually eaten away when near electric wires. In that case the streets will have to be torn up from time to time for repairs.

EDISON ILLUMINATING COMPANY.—There is a report in local financial and commercial circles that the Edison Illuminating Company may reorganize. The company does nearly all the city's lighting. Its bonded indebtedness is nearly $4,000,000, and its capital stock is $4,000,000 even. The semi-annual interest on the bonds falls due Feb. 1, and there is considerable gossip to the effect that the interest would not be met. The Board of Directors had a meeting a few days ago and sent out circulars outlining, it is said, the following plan: The semi-annual interest on $3,610.000 6 per cent. bonds, which amounts to $108,300, will be allowed to lapse. Bondholders would then be offered a $500 bond in a new company for each $1,000 bond of the present issue. The new bonds would only bear 4 per cent. interest, and with each one would be given 10 shares of preferred and 10 shares of common stock in the new company. This would reduce the bonded indebtedness to $1,805,000 and would reduce the annual interest charge from $216,600 to $72,200.

Canadian Notes.

MONTREAL, CAN., Jan. 25, 1897.

MR. FREDERIC L. WANKLYN, of Montreal, has been appointed general manager of the Toronto Street Railway, and will take over his new duties on Feb. 1.

ELECTRICAL FIRE APPARATUS.—A movement is on foot to improve the fire brigade of Montreal by the addition of an electric fire engine, electric motor and pumps to be mounted on a car run on the street car rails, the power to be supplied from the trolley wires.

WAR OF PRICES.—There is a commercial war on in Hull between the Hull Electric Company and the Ottawa Electric Light Company, The former company some days ago reduced its figures for lighting from 15½ to 12½ cents a light per week. Now the Ottawa Electric Light Company has done the same.

TO AMEND A TELEPHONE ACT.—Application has been made to Parliament for an act to amend the Columbia Telephone & Telegraph Company's act 1896, to enable the company to construct telephone and telegraph lines anywhere in the Province of British Columbia and the Northwest Territories. Angus MacNish is agent for the company.

TELEPHONE IN NORTHWEST CANADA.—Application is being made to the Legislature of Ontario for power to construct lines of telegraph and telephone from Bonheur station on the Canadian Pacific Railway or from some other convenient point on the said railway in the District of Rainy River or in the District of Thunder Bay, in the Province of Ontario, to Sawbill Lake, Hawke Bay, Lake Harold, Sturgeon Falls, Mine Centre, Foley and Fort Francis. Bristol & Cawthre, Toronto, are solicitors for the applicants. The name of the company is the Seine River Foley & Fort Francis Telegraph & Telephone Company

OTTAWA, CAN., Jan 25, 1897

AFTER MORE BUSINESS.—In an effort to capture a portion of the business of the Consumers' Gas Company, the Toronto Electric Light Company has decided to reduce the price of lights to householders by 33⅓ per cent.

PROPOSED RAILWAY.—Application is being made to the Ontario Legislature by the Desbarats & Northern Railway Company for permission to build a steam or electric railway from a point on the southerly shore of St. Joseph's Island, in the District of Algoma, to a point on James Bay at or near Moose Factory.

FORT ERIE FERRY RAILWAY.—This company is applying for power to increase its capital stock to $250,000 and for power to extend its railway from its terminus in the village of Fort Erie to the village of Chippewa, to run through the villages of Fort Erie and Bridgeburg and the eastern portions of the townships of Bertie and Willoughby, and to be operated either by steam or electric power.

DUTIES ON STEEL RAILS TO BE REFUNDED.—An Order in Council has been passed sanctioning the refunding of the duties paid on steel rails for street railways from 1887 to March 27, 1894, when the present law came into force. The whole amount under this head is some $138,000, of which $50,000 was by judgment awarded the Toronto Street Railway, and $50,000 is claimed by Messrs. Ross and Mackenzie for the Montreal Street Railway.

REPORT OF THE OTTAWA ELECTRIC RAILWAY COMPANY.—The annual report for 1896 of the Ottawa Electric Railway Company is a striking indication of Ottawa's progress. The total number of passengers carried in the Ottawa electric cars in 1892 was 1,520,405, with receipts of $71,698.99. In 1896 the number of passengers carried was 4,583.235, with receipts of $212,105.85. Four quarterly dividends of 2 per cent. each were paid during the year. The Board of Directors was re-elected as follows: J. W. McRae, G. P. Brophy, William Scott, T. Ahearn, Thomas Workman, Peter Whelen, Warren Y. Soper

English Notes.

(From Our Own Correspondent.)

LONDON, Jan. 20, 1897.

FREE LAMPS.—The free lamp idea has taken somewhat in the new development at Bedford. The idea as originally propounded at Bradford was to give every consumer quarterly doles of lamps, the size of the doles being based upon the size of the last quarter's bills. The Bedford Town Council, however, has decided to pay the usual discounts they allow their big customers and those who pay their bills promptly, in kind instead of in cash.

A NEW RECORDING VOLTMETER.—Messrs. Elliott Brothers, who have been considered the most conservative of instrument makers, are moving with the times. A few years ago they took up the English agency for the Weston instruments, and they have now just put an exceedingly good recording voltmeter on the market which presents several new features. In the first place the clock is stationary and does not rotate with the drum. This enables a very large chart to be put in, so that it need only be renewed once a month. The principle of the voltmeter is the Weston or D'Arsonval one, only an electromagnet is used instead of a permanent magnet. The controlling force is a weight. The pen is held on a stirrup at the end of an aluminum arm, rendering it impossible for those zealous switchboard attendants, whose ambition is to beat the record of constant pressure, to "regulate" to a maximum the tension on the pen.

THE "BLOT" ACCUMULATOR.—A new accumulator designed by M. G. R. Blot, of Paris, has been put on the market. The cell is of the Planté type, each plate being made up of several longitudinal coils of lead ribbon. The windings of these coils are alternately of embossed and flat roughened ribbon, so that a very large surface of plate is exposed. The "Blot" Company claim that a kilogramme of plate offers a surface of 0.33 square metre. The way the plate is built up enables it to swell to a great extent, so that there is no tendency to buckle, even when the cell is short circuited. At a recent press view of the new secondary battery a nine plate cell with plates about 12 inches by 8 inches, (the nine plates weighing six kilogrammes), was charged for a quarter of an hour with a current of 140 amperes, and then discharged at 20 amperes. From tests made last year by Mr. Preece, of the Post Office, a capacity of 12.7 ampere hours per kilogramme of plates was obtained at an ampere-hour efficiency of 88 per cent. and a watt-hour efficiency of 76 per cent.

THE WARD ELECTRICAL OMNIBUS.—It is now six months or more ago since it was announced that the London Road Car Company proposed shortly to place a new line of 'buses upon the streets of London. I ascertained at the time that there was absolutely no foundation for this statement, and since then all that has been published in the press has made less demands upon our credulity. However, we are still constantly being assured that the electric omnibus is "about to start." Moreover, representatives of the technical press are jealously excluded from the precincts of the only two electric omnibuses in existence in the metropolis. Representatives of the daily press, were, however, recently invited to inspect a trial trip. The wheels of the newer omnibus are only about 2 feet in diameter, each pair of wheels being driven from an independent motor from chain gearing, the reduction ratio being 20 to 1. There is a magnetic clutch worked by the same handle as the rheostat, by means of which this ratio is given two higher values. Resting on transverse springs on the under-frame are nine rectangular air cushions about three inches high filled with compressed air. The car itself rests on these cushions, being kept in position by two strong hinges on either side. There are 35 cells under the seats of each side of the interior of the vehicle These cells are of a mysterious type known as the "Sola," the plates being tightly held against one another without any insulation or separators. The grids are only about ⅛ inch thick, the material on each side of the grid being twice as thick as the grid itself.

JACOB BRETT.—Mr. Jacob, well known in connection with the Channel cable, died a few days ago at the ripe age of 89 Mr. Jacob Brett took out his first patent in connection with the telegraph in 1845, and on June 16 in that year he registered a company which he called the General Oceanic Telegraph Company. The objects of this concern were specified to be the establishment of communication by electric telegraph between the British Isles and Continental countries, across the Atlantic Ocean to Nova Scotia and other colonies. On July 21 in this year Mr. Brett appears to have laid before the then First Lord of the Admiralty a plan for connecting the Government offices in this country with the most distant parts of the United Kingdom and the colonies, which letter was communicated to Sir Robert Peel, then Prime Minister, a few days afterward. The full significance of this can only be appreciated if we recall to our minds that at this time submarine telegraphy was practically unknown, and that the earliest telegraph company in the world, the Electric Telegraph Company, was not incorporated until the following year, and only opened its offices for the reception of land line messages in 1848. The brothers Brett having failed to obtain sufficient pecuniary support in England for their telegraphic schemes, applied in April, 1847, to the French Government. King Louis Philip subsequently made a concession for a cable to be laid from Dover to Paris, though the concession was not an exclusive one. After some further delay an exclusive concession was obtained in April, 1849, from Louis Napoleon, then president of the French

Republic. On Aug. 28, 1850, the two brothers, at their own cost, and with the assistance of some friends, laid the first submarine cable in the world, *viz.*, the line connecting Dover with Cape Griz-Nez, in France, type-printed messages being transmitted through this line. As this cable had no iron sheathing and was merely a single copper conductor insulated with gutta-percha, it soon collapsed. In the following year these indefatigable pioneers formed a submarine telegraph company, and laid a successful four-conductor iron-sheathed cable of the type now universally in use. Subsequently the two brothers formed the Mediterranean Telegraph Company, and in 1854 laid a cable from Algiers across the Mediterranean to Sardinia and Corsica. They also made many endeavors to form a company to carry out cable communication between Suez and India. In 1852 they formed the European and American Telegraph Company, which afterward became the Magnetic Telegraph Company and was eventually amalgamated with the British Telegraph Company. They also laid the two underground lines to Birmingham and Manchester. Although Mr. John Watkins Brett took a prominent financial part in the inception of Atlantic telegraphy, he did not live to see its successful accomplishment, and by the time the 1866 cable was working, Mr. Jacob Brett had retired into private life, having no means of his own to enable him to associate himself any longer with the financial side of telegraphic enterprise. During the last years of his life, Mr. Brett lived almost in penury. In 1886 the Government granted him a Civil List pension of £100 a year, which was supplemented in 1892 at the instance of the Institution of Electrical Engineers by a grant of £200 from the Royal Bounty Fund, and on Christmas eve last, a memorial for a further grant from this fund was signed by Lord Kelvin, Lord Rayleigh, Dr. John Hopkinson, Mr W. H. Preece, Sir Henry Mance and Mr. Latimer Clark. Notwithstanding his great poverty and infirmities, Mr. Brett was not soured by his comparative lack of worldly success, but bore all his difficulties with great fortitude. He received considerable assistance from various old telegraphic friends, which prevented the last years of his life from being passed in absolute want.

General News.

NEW INCORPORATIONS.

THE PALL MALL ELECTRIC ASSOCIATION, OF NEW YORK, has been incorporated to manufacture electric magneto-curative articles. The incorporators are Ruth E. Scott and Georgiana Scott, of New York, and John J. McGinty. Capital stock, $5000.

THE MICHIGAN TRACTION COMPANY, Kalamazoo, Mich., has been incorporated with a capital stock of $500,000. The company will acquire the rights of the Citizens' Street Railway Company, of Kalamazoo, and build the proposed electric road from Kalamazoo to Battle Creek.

THE CITIZENS' MONONGAHELA STREET RAILWAY COMPANY, Pittsburg, Pa., has been chartered to build a line four miles long from Mount Washington to the Union Depot. The directors are James H. Bailey, president; William Halpin and William H. Minnich, of Pittsburg. Capital stock, $24,000

THE LANCASTER ELECTRIC LIGHT & HEAT COMPANY has been organized in Lancaster, Pa , with a capital stock of $50,000. Those interested in the company are John B. Oblinger, Byron G. Dodge, William Blair, Gustavus Groezinger, B. J. McGrann, R. H Brubaker, Eugene G. Smith and W. F. Beyer.

THE MANSION ELECTRIC COMPANY, Reading, Pa., has been granted a charter with $20,000'000 full paid in. The parties interested are: F. E. Bailey, of Philadelphia, president and general manager; Henry B McCormick, secretary and treasurer; Vance C. McCormick, J. M. Cameron, and L U. Bailey, of Harrisburg. The plant has been started and has a capacity of 2000 lights. It was built by F. E. Bailey & Co., of Philadelphia.

THE TITUSVILLE ELECTRIC TRACTION COMPANY, Titusville, Pa., has been formed for the purpose of building an electric road through the counties of Crawford, Venango and Warren, starting at Pleasantville and running to Titusville, Hydetown and East Titusville, a distance of 15 miles. Those interested are M. B. Dunham, Warren; George H. Dunham, Pleasantville, and A. J. Hazletine, of Warren. Capital stock, $100,000.

TELEGRAPH AND TELEPHONE.

OMAHA, NEB.—The Nebraska Telephone Company is constructing a telephone connection with Fort Crook.

FORT WORTH, TEX.—The Southwestern Telegraph & Telephone Company is extending its line from this city to Hillsboro.

WINONA, MINN.—The Northwestern Telephone Exchange Company's new line has just been completed and connection is thus made between Winona, Rochester, Lewiston, Utica, St. Charles, Dover and Eyota.

JEFFERSONVILLE, IND.—The Ohio Valley Telephone Company has reduced its rates in this city and New Albany, and from Feb. 1, the monthly charge will be $2 for business houses and $1 for residences.

CHETOPA, KAN.—J. B. and G. H. Spangler have completed the telephone system for the city, and arrangements are being made to connect it with the Oswego, Parsons and Independence system, and thence to Kansas City.

ELECTRIC LIGHT AND POWER.

ANGELICA, N. Y.—The final arrangements have been completed for the installation of an electric light plant at this place. The cost is estimated at about $13,000, the plant to be in operation about April 1.

MANKATO, MINN.—The Council voted to receive bids Feb. 6 for an arc electric lighting plant and for the bonds necessary to pay for the plant. The question of municipal ownership has been agitated for four years.

NORFOLK, VA.—Among other improvements at the wharf of the Old Dominion Steamship Company will be an extensive electric light plant and a new fire apparatus. These will be erected in the near future.

POTTSVILLE, PA.—The Pottsville Council has awarded to the Edison Electric Illuminating Company the contract for lighting the streets at these yearly prices: $84 for arc lights and $22 for incandescent lights.

CHATTANOOGA, TENN.—The new plant of the Chattanooga Electric Light & Power Company was put into operation for the first time on January 17. It is to be one of the most complete electric light plants in the South.

HYDE PARK, N. Y.—Frederick W. Vanderbilt is to have an electric light plant installed at his home, the Langdon Estate. The mansion, farm houses, stables, and all the buildings on the place are to be lighted, and electric lights are to be placed along the highway.

BRYAN, TEX.—At a meeting of the City Council a committee was appointed to confer with Capt L. T. Fuller, manager of the Bryan Water, Ice & Electric Light Co., with a view to changing the incandescent system of city lighting now in use for the arc system.

BELLEVILLE, N. J.—The Kearney Electric Light & Power Company has secured the contract from the Belleville Township Committee to furnish electric light to Silver Lake, otherwise known as the fourth district of Belleville. The lights were turned on recently for the first time.

ROCKVILLE, MD.—The Town Council has awarded the contract for the construction of the water works and electric light plants to the Standard Boiler & Bridge Company, Bellaire, O., at its bid of $16,888. The contract calls for the completion of the electric light plant by May 15.

UPPER SANDUSKY, O.—Upper Sandusky is soon to have an incandescent light service. There have been arc lights in the city for some time, but owing to the great demand for incandescent lights, the Citizen's Electric Light & Power Company has decided to make such an addition to its plant.

BAY SHORE, L. I.—The recently organized stock company for the lighting of the streets of Bay Shore has purchased a building for the electric light plant. It is situated directly upon a canal connecting with Great South Bay, this location affording good facilities for the reception of coal and other supplies.

OSWEGO, N. Y.—Owing to the water being drawn from the hydraulic canal and an accident to the engine at the power house of the People's Electric Light Company, the town has been in darkness over a week, and no street cars have been run during that time. It is possible that it will be about a month before the lighting and street railway service will again be in operation.

LANCASTER, KY.—At a meeting of the City Council it was decided to light the city by electricity, provided satisfactory arrangements could be made. A committee was appointed to consult with local electricians as to the best system to adopt, relative to cost, etc , preliminary to the advertising for bids for a plant Franchise was also asked for the establishment of a local telephone exchange.

PITTSBURG, PA.—The electric lights which have burned in the City Hall for the past 12 years are being replaced by gas light. The reason given for the change is that of economy, the electric light costing $4000 a year, while under its franchise with the Pittsburg Gas Company the city receives free 12,500,000 cubic feet of gas annually. The saving was so great that it was decided to make the change, notwithstanding the inconvenience to those who are employed in the City Hall.

DALLAS, TEX.—The present contract with the Dallas Electric Company for lighting the city will expire on Nov. 3 next. The Common Council has passed an order that the Light Committee, in connection with the city electrician, investigate and report what, in their opinion, would be the most economical and satisfactory course to pursue and what system of lighting would be the most satisfactory and cheapest for the city to use. It was further ordered that the said committee and electrician investigate the surplus boiler capacity now at the Turtle Creek pump house, and submit an estimate on the necessary machinery and construction material for 300 arc lights.

THE ELECTRIC RAILWAY.

NEW LEBANON, N. Y.—The Brainard, Nassau & Albany Electric Railway will probably be extended to New Lebanon.

SOUTHBRIDGE, MASS.—The Selectmen of Southbridge and Charlton will be asked to grant a franchise for an electric road from Southbridge to Charlton depot.

MILFORD, MASS.—The Milford Selectmen tendered a franchise to the Milford, Holliston & Framingham Street Railway Company for an extension of its line to Caryville and Medway.

HARTFORD, CONN.—A bill has been introduced in the State Senate to repeal the parallel street railway act. A number of petitions were also introduced for new trolley roads and extensions of existing ones

SUTTON, MASS.—The directors of the Sutton & Douglas Electric Street Railway Company have petitioned the Selectmen of Sutton for the right to locate and construct tracks, etc., for the purpose of operating a street railway.

HAGERSTOWN, MD.—Plans have been completed for the construction of a power house for the Hagerstown Electrical Company. The building will be one story high, of brick and iron, with a slate roof. It is estimated that the entire cost of the power house will be $25,000.

MYERSVILLE, MD.—The Myersville & Catoctin Railway Company has been formed. The intention of the company is to build an electric road from Middletown *via* Myersville, to a point on the line dividing the county of Frederick from the county of Washington, eight miles in length.

NEW HAVEN, CONN.—Bills have been introduced in the Connecticut legislature providing that all grade crossings of steam roads and highways existing prior to 1889 shall be eliminated at the exclusive cost of the companies instead of having the towns bear part of the expense as now.

PLAINVILLE, CONN.—T. H. McKenzie, of Hartford, has been engaged by General Manager Walkley, of the Southington & Plantsville Tramway Com-

pany, to make surveys at once for the proposed extension of the line to Plainville, to connect with the Central Railway & Electric Company's lines.

ALLENTOWN, PA.—A corporation, known as the East Penn Traction Company, intends to build a line through Lehigh County, beginning at the Bucks County line on the road leading to South Bethlehem to the Northampton County line. A. S. Cadwallader, of Philadelphia, is president of the company.

WORCESTER, MASS.—The project to connect this city and Marlboro with a street railway is again being brought up. Final surveys are being made in the towns through which the lines will pass, and work will be commenced as soon as possible. Tucker, Anthony & Co. will furnish the money for the construction of the road.

CHICAGO, ILL.—A committee has been formed for the protection of the bondholders of the Englewood & Chicago Electric Street Railway Company, and for the purpose of formulating a plan for the reorganization of the company. The bondholders are requested to deposit their bonds without delay with the Manhattan Trust Company.

NORWAY, ME.—A meeting of the business men was held to consider the feasibility of building a road from this town to Waterford, with branches to Stoneham and Harrison, and possibly as far as Bridgeton. The total length of the line, which the Oxford Central proposes to build, will be about 31 miles. E. W. Eastman, of Auburn, is interested in the scheme.

NEW BRUNSWICK, N. J.—The plan to connect this city by trolley with Bound Brook, and to extend the lines from Plainfield to Dunellen, Bound Brook, Somerville, and eventually to Princeton, Trenton and Philadelphia, has taken definite shape, and the New York & Philadelphia Traction Company has applied for right of way in Middlesex and Somerset Counties.

ROCKLAND, MASS.—The Norwell & Scituate Street Railway Co. has been granted a franchise to lay tracks and operate a street railway in the town of Scituate and the work of construction on the new line will be begun in the Spring. The proposed road will extend from the end of the present Hanover Street Railway at Assinippi to Scituate Harbor, a distance of about nine miles.

Obituary Note.

MR. L. H. HART, business manager of *Heating and Ventilation*, New York City, and secretary of the American Society of Heating and Ventilating Engineers, died at his home in Brooklyn, on Jan. 25, of an affection of the heart, resulting from an attack of the grip. Mr Hart was well known in the electrical trade through his former connection with THE ELECTRICAL WORLD, first as its New England representative and then in the main office at New York. He was born 38 years ago in Connecticut, in which State he served some time as a telegraph operator. From this he drifted into railroading, and was afterward traveling passenger agent for the New York, New Haven & Hartford Railroad. While in the latter service he was elected to the Connecticut Legislature, serving one term therein with considerable credit to himself. He then became connected with THE ELECTRICAL WORLD. In 1893 he started for himself the paper *Heating and Ventilation*, the success of which is largely due to his great energy and enterprise. He was one of the prime movers in the formation of the American Society of Heating and Ventilating Engineers, and would have taken a prominent part at its next annual meeting, which will soon be held in this city. Mr. Hart had a very large acquaintance and was highly esteemed by all. He had the happy faculty of making friends and never losing them. The funeral services were held at the house on the evening of Jan. 26, a large number of the deceased's former friends being in attendance. His sudden death is mourned by his many friends.

Legal Notes.

RECEIVER APPOINTED.—The Sandusky Electric Railway Company, Sandusky, O., went into the hands of a receiver on Jan. 23, because the company is behind in its interest on bonds, and the employees have have not been paid for several weeks. Mr. Clark Rude was appointed receiver. The indebtedness of the company is about $120,000.

THE THOMSON-HOUSTON ELECTRIC COMPANY OF NEW YORK.—The Court of Appeals at Albany, on Jan. 26, dismissed the appeal taken in the case brought by the Holland Trust Company to foreclose a mortgage of $600,000 given by the Thomson-Houston Electric Company of New York. Certain coupon holders contended that under the terms of the mortgage the coupons were entitled to priority of payment over bonds. This decision, it is stated, finally determines the litigation.

THE KINGSBRIDGE EXTENSION.—Suits have been brought by Dorothy R. Christ and Catharine L. Beekman to prevent the Third Avenue Railway Company from building the overhead trolley extension on the Kingsbridge road north of 162d Street. The plaintiffs claim that such a road would damage their property. Counsel for the railroad company asserted that neither of the plaintiffs had a right to ask for consideration as to a restraining order against the construction of the proposed road anywhere except opposite their own real estate. It was further alleged that the plaintiffs had neglected to appeal to the courts until after the railroad company had expended about $2,000,000 on the extension.

LARGE VERDICTS AGAINST TROLLEY COMPANIES—A verdict of $10,000 was given in the Supreme Court, Brooklyn, N. Y., on Jan. 22, against the Brooklyn Heights Railway Company, in the suit brought by 13-year-old Isaac Traukiner, whose left arm was amputated as a result of a trolley accident. In the same court, on the same day, the Third Avenue Railway Company, New York, was mulcted in the sum of $7,000 in the suit brought by Mrs. Margaret Ulmer for the death of her husband, who was killed by being thrown against an elevated railroad pillar as he was getting off a Third Avenue car on Aug. 26 last. In the suit of Isaac Myerowich against the Consolidated Traction Company, of New Jersey, the Supreme Court in Jersey City, on Jan. 22, gave judgment for $7,000. Myerowich was thrown from his wagon, which was struck by a trolley car, and sustained severe injuries which laid him up for several weeks. He sued the company for $30,000.

Personal Note.

MR. C. LE BLANC, of Paris, arrived in this city on the Steamer *St. Louis*, on Jan. 23. Mr. Le Blanc's company represents in Europe the Walker Company, Cleveland, O. He reports having just closed a contract for the electric road at the Brussels Exposition and his company has at the present time 28 roads in operation and under contract Mr. Le Blanc will return to Paris in about two weeks.

Trade and Industrial Notes.

THE CREFELD ELECTRICAL WORKS, Boston, is now represented in New York by Mr. D. G. Scott at 136 Liberty Street, who will take pleasure in quoting prices on wire or anything else manufactured by the company.

THE MOORE-EDENFIELD ELECTRIC & MANUFACTURING COMPANY has been organized to succeed to the business of Messrs. Moore & Edenfield, of Augusta, Ga. Mr. R. J. Edenfield is general manager and Mr. George P. Weltch is treasurer.

THE METROPOLITAN ELECTRIC COMPANY, Chicago, has been given the Western agency of the Bernstein lamps, both arc and incandescent. These lamps are among the best sellers on the market, and those not already using them would do well to give them a trial.

NIGHTINGALE, JOHNSON & CO., 26 and 28 Catharine Street, Utica, N. Y., have closed several contracts since Jan. 1 for their special iron slate-lined junction boxes, for which there is a good demand. They report that there is a decided improvement in business in their territory.

THE ELECTRIC STORAGE BATTERY COMPANY, Drexel Building, Philadelphia, Pa., has just issued a catalogue and price list of chloride accumulators of all sizes, and used for various purposes. The advantages of storage batteries for central stations, power plants, regulation and isolated plants are described quite fully.

USEFUL CALENDAR.—We have received from the Electric Appliance Company, Chicago, a copy of its 1897 calendar, which gives, besides a good many trade suggestions, a unique moonlight schedule. The latter feature will no doubt be appreciated by central station men who render electric light service on the moonlight basis.

NEW PLANT.—Application has been made for a charter for the Birdsboro Electric Company, by F. E. Bailey, of Philadelphia, George Brooke, George Brooke, Jr., Robert and Edward Brooke, of Birdsboro. Work has been started on the plant; it will be in operation by the 1st of June, and will have a capacity of 1000 lights. F. E. Bailey & Co., Philadelphia, have the contract for the complete plant.

CARD ELECTRIC COMPANY, Mansfield, O., has just issued a neat pamphlet containing about 100 testimonials from as many concerns throughout the West, Northwest and South, regarding the work of the company's multipolar generators and motors. These letters speak very highly of these machines, and the Card Electric Company has good cause for congratulating itself over the excellent record made by its apparatus.

THE UTICA FIRE ALARM TELEGRAPH COMPANY, Utica, N. Y., is one of the oldest and best known manufacturing concerns of its kind in the electrical field. Its magneto bells, switchboards, etc., are regarded as standards of excellence. The executive officers of the company are Messrs. F. W. H. Sheffield, S. J. Tunbridge and A. C. Palmer, who are constantly on the lookout to devise methods by which the quality of their goods may be improved.

THE UPTON ARC LAMP.—The 100 and 150 hour direct-current constant potential arc lamp is rapidly gaining favor in this particular branch of arc lighting. The Electric Appliance Company, Chicago, as general Western agent for the Upton arc lamp, reports that it will soon be prepared to supply its customers with a long burning Upton arc lamp, which has features not possessed by any other lamp on the market, the principal one being the entire absence of feeding or regulating mechanism.

THE DAYTON GLOBE IRON WORKS COMPANY, Dayton, O., has issued a 1897 calendar on which is given a 9 by 7¼ inch photograph of what is claimed to be the largest horizontal turbine outfit ever constructed. This outfit was built by the Dayton Company for the Boston & Montana Consolidated Copper & Silver Mining Company, Great Falls, Mont., and consists of a pair of 57-inch new American special turbines, mounted horizontally on 10-inch shafts, working under 50 feet head and developing 3945 horse-power.

THE BOSSERT ELECTRIC CONSTRUCTION COMPANY, Utica, N. Y. seems to be meeting with increasing success with its panel and distributing boxes, main and feeder terminal boxes, and steel drawn switch, wall and ceiling boxes. Engineers and contractors speak highly of the merits of these devices The company has recently secured some very nice orders, and Messrs. W. C. Bossert, the president, and S C. Adams, the secretary, are to be congratulated upon this substantial recognition on the part of the trade.

THE RAILWAY ADVERTISING COMPANY, 261 Broadway, New York, has issued a neat little pamphlet entitled "Book of Transfers of the Metropolitan Street Railway Company's Lines." It contains a list of the various transfer stations of the Metropolitan Company, also a map of the city, showing the location of the transfer points. It also gives the routes of the various lines controlled by the Metropolitan Company. This little pamphlet will be found very useful to those who have frequent occasion to patronize the surface lines.

THE AMERICAN ENGINE COMPANY, Bound Brook, N. J., builder of the American-Ball engine, has issued a pamphlet giving a list of the purchasers of engines designed by Mr. F. H. Ball. The list is a very long one and covers every State in the Union and several foreign countries. It is published as a convenient reference for prospective purchasers of engines. The American-Ball engine embodies new and valuable improvements, which are fully described and illustrated in the Company's catalogue, a copy of which can be had on application.

THE UTICA ELECTRICAL MANUFACTURING & SUPPLY COMPANY, Utica, N. Y., reports a large and increasing demand for the well known switches, lightning arresters and fuse boxes, of which it manufactures a complete line. The company carries a large stock, and is prepared to fill orders promptly. Messrs. M. J. Brayton, secretary, and W. C. Balda, manager, have had wide experience, and the close personal supervision they give to the business is a guarantee that only the best material and workmanship are employed in the manufacture of these specialties

MESSRS. TOWER, BLANKENSHIP & BINFORD, 704 East Main Street, Richmond, Va., have issued a nicely gotten up, well illustrated catalogue of dynamos, motors, fans and electrical supplies Among the goods handled by this firm are Lundell motors and dynamos, electric fans, "Manhattan" standard incandescent arc lamps, interior conduits, switches of all kinds, sockets, lamp cord, Grimshaw tape, cut-outs, insulators, electric and combination switches, wire gauges, telephone instruments and batteries, etc., etc.—in short, the firm deals in ever ything electric.

K. McLENNAN & CO., Chicago, sole manufacturers of the celebrated Gale's Commutator Compound, report that requests for samples still continue and before long they believe all the power stations will have been covered, as well as many isolated plants in the United States and Canada. They state that they have already gained a foothold in Mexico, and in the past two weeks have made large shipments to that country. It is their desire that every user of a dynamo should try one of their free sample sticks, which may be had on request to their office, 1128 Marquette Building.

F. E. BAILEY & CO., Betz Building. Philadelphia, Pa., representatives of the Armington & Sims Engine Company, have the contract for building a complete electric light plant at Birdsboro, Pa., to have a capacity of 1000 lights and to include a 100-hp engine. They have just completed a 2000-light plant for the Mansion Electric Company, Reading, Pa., that includes one 125-hp and two 40-hp engines, and have installed a 125-hp engine for the Borough of Quakertown, Quakertown, Pa., and one 600-hp engine for the Nanticoke Light Company, Nanticoke, Pa. The above engines are of the Armington & Sims new self-oiling type, with new governor.

THE STEWART HEATER COMPANY, Buffalo, N. Y., is meeting with gratifying success with its feed-water heater and purifier for use in connection with electric light and power plants. Mr. D. P. Stewart is president of the company and personally supervises the manufacture of the heater. Mr George A. Otis is the inventor of the heater and has charge of the sales department. The device is constructed of seamless brass tubes and is guaranteed to heat the feed water to the boiling point with the exhaust steam without causing any back pressure. Electrical companies requiring a feed water heater will do well to investigate the merits of the Otis.

"THE TRADESMAN."—The 18th annual number of *The Tradesman*, published at Chattanooga, Tenn., contains over 260 pages, and presents the most complete, exhaustive and valuable review of the South, its resources, development and possibilities, that to our knowledge has ever been published. The special articles are from the leading thinkers, statisticians and business men in the country; the information given is the result of careful investigation and practical knowledge. The business directories and statistics are most valuable features of this valuable number. Of the many features is a complete directory of 5000 of the leading industrial plants of the Southern States.

MESSRS. CRAFT & ISSERTEL, New York, sales agent for the Walker Company, are receiving the congratulations of their many friends in the electrical field upon having secured, in the face of severe competition, the contract for the electric lighting plant for the new Waldorf Hotel in New York. Another contract recently secured by this enterprising firm is for a 300-hp lighting and power plant for the Henry Heide candy factory in New York, in which Walker 100, 75 and 50 kw machines will be used. The factory is notable in that it uses Crocker-Wheeler independent motors for each piece of machinery, dispensing with all belting and shafting. Among recent contracts installed by Messrs. Crafts & Issertel are the Murray Hill Hotel and the Windsor Hotel in New York, and the Mergenthaler Linotype Company's building in Brooklyn.

"H. W. J." ELECTRIC HEATERS.—The H. W. Johns Manufacturing Company, 87 Maiden Lane, New York, has just issued a price list of the "H. W. J." electric heaters. The construction and application of these devices are described and illustrated quite fully. The company lays particular stress upon the large amount of radiating surface furnished by the heaters, as many of them as possible being placed in a car, in order to obtain this surface. The result is very noticeable in the heating of the cars, which are uniformly heated throughout at a gentle temperature, while the heaters themselves remain comparatively cool. Tests have shown that the heater resistance-wire also attains a comparatively low working temperature. This is stated to be the result of the greatly increased radiating surface created by the increased surface of the mat per linear foot of wire. The pamphlet gives directions for the installation of these heaters, so that any one at all conversant in these matters can install the heaters without the services of an expert.

MORRIN "CLIMAX" BOILER.—The Clonbrock Steam Boiler Company, Brooklyn, N. Y., has issued an elaborate catalogue of the Morrin "Climax" water-tube safety boiler manufactured by it. The catalogue contains a large number of half tone and line illustrations, showing the several departments of the company's works and various examples of its products. The construction of these boilers in its different stages is also shown in a very clear manner by the aid of illustrations, and a complete description of the boiler and its advantages are set forth. A large number of letters are presented from concerns using "Climax" boilers, regarding the satisfactory service performed by the same. Reports of tests on boilers in various well known manufacturing plants are given, showing very advantageously in favor of the "Climax." At the back of the catalogue is given a large quantity of useful information for engineers, and taking it altogether, the book is one of the best productions of the kind that has been issued for a long time.

THE FUEL ECONOMIZER COMPANY, of Matteawan, N. Y., has issued a very artistic pamphlet on the Green improved patent fuel economizer for steam boilers. The frontispiece consists of a very handsomely colored illustration, giving a perspective view of the application of this economizer in practice. The pamphlet is very profusely illustrated and contains a great deal of valuable information concerning the advantages of the economizers in practical use. It is claimed for the Green economizer that it saves from 1 to 20 per cent. in fuel and heats the feed water economically to high temperatures, considerably above what can be obtained by other means. By this system the heat from the escaping gases, which would otherwise go to waste, are practically utilized and it affords an abundant supply of water at the evaporative point, ready for immediate delivery to the boiler. Some valuable engineering tables are given; also a long list of concerns in the United States, Canada and foreign countries equipped with the Green economizer, together with plans of some of the most notable installations.

LARGE CONTRACT FOR POLES.—The largest sale on record of manufactured yellow pine poles has recently been made by Mr. S. C. Strock, 50 Broadway, New York City, to the American Telephone & Telegraph Company for use on its lines. The order calls for 8000 tapering poles ranging from 25 to 55 feet in length, and if placed at about 125 feet apart, will serve for about 200 miles of line construction. Other figures in connection with this notable order may be of interest. Allowing an average of 30 feet per pole, the 8000 poles would extend over 45 miles if placed end to end. The transportation of the entire lot, allowing 45 poles to each car, will probably require 180 ordinary 35-foot freight cars, or about nine train loads, which, if put end to end, will give about one mile of cars carrying electric poles. These poles are to be square cut from long-leaf yellow pine, tapering from large butts to one half the size at tops, and are to be creosoted before use. This is by no means Mr. Strock's debut in the electrical field. He was formerly connected with the Thomson-Houston and General Electric Companies.

IMPROVED STEAM GENERATOR.—The Hascall-Richards Steam Generator Company, 36 Bromfield Street, Boston, is the manufacturer of the Bush steam generator and water circulator, which is claimed to increase the capacity of any existing boiler from 10 to 33⅓ per cent., according to conditions. The device is attachable to any style of boiler and is claimed to be an excellent expedient where the steam and power of the boiler must be increased without encroaching upon the surroundings, that is, without extending the present space. Among the other claimed advantages derived from the use of this generator, may be mentioned the prevention of foaming and scaling, all sediment being removed, thus rendering incrustation impossible; it enables the generation of steam 20 to 30 minutes quicker than by any other process ever applied to a boiler; it can be applied to any boiler without removing the masonry work or involving loss of time by shutting down, and it produces a constant and rapid circulation of water in the boiler and generator. In brief, the device consists of an arrangements of piping exterior to the shell of the boiler and situated in the furnace gases so as to afford additional heating surface, thus affording a simple means of adding the necessary capacity without increase of room and with little expense There are also some special advantages gained in the matter of quick steaming by reason of the breaking up of the water into a number of columns favorably situated with reference to the fire, and the tubes may be so connected as to insure a brisk circulation with the attending beneficial results, both in cleanliness and increased efficiency and heating surface

Business Notices.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 67–71 Park Place, New York City.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, 105 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JAN. 19, 1897.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

575,322. INCANDESCENT LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed March 16, 1896. In an incandescent lamp socket, the combination with a base of insulating material having a recess in the end for the reception of the lamp-base, threads formed in the walls of said recess to engage the threads upon the lamp-base, of a contact-plate or terminal fitting in a slot upon one side of said recess and carrying a binding-screw, said base being provided with a recess in the side in which said binding-screw rests, a contact-plate or terminal in the bottom of said recess and carrying a binding-screw, said base being provided with a recess in the side within which said binding-screw rests, and a shell surrounding said base and exposing said recesses containing the binding screws when removed.

575,332 ELECTRICALLY ILLUMINATED JUGGLERY APPARATUS; M. Cronin, London, Eng. App. filed Oct. 30, 1896. Electric-light-transparency jugglery apparatus, consisting of electric battery cells provided with expansible gas receptacles over their filling inlets, said cells fixed to a foundation plate of ebonite or the like having one or more electric glow-lamps fixed thereto, and an outer enclosing sheet-metal hollow frame made in detachable parts, and within which the said foundation-plate is fixed, said

frame having holes provided with colored transparent material and with a switch for turning the light on or off.

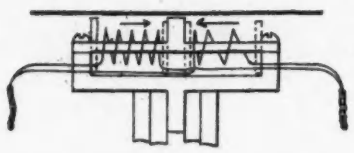
575,341. CLUTCH FOR ARC LAMPS; E. Finkbeiner, Brooklyn, N. Y. App. filed July 27, 1896. In a regulator for electric arc lamps, the combination with a tube through which the carbon-holding rod is adapted to pass, of a pair of eccentrics journaled at the upper end of said tube, levers fulcrumed to the respective spindles of said eccentrics and having slots in their outer ends, a device adapted to move vertically on said tube and having projections passing through the slots of said levers, and a pivoted carriage supporting said projections.

575,346. ELECTRIC RAILWAY; W. Grunow, Jr., Bridgeport, Conn. App. filed Oct. 28, 1895. An underground conduit for electric railways, comprising a metal trough, having a flexible cover or top composed of flexible metal plates each of which is secured to the sides of the trough and to the depressible rail, said plates being curved inwardly at their adjacent edges, and securely bolted between strips of insulating material, between which is placed a depressible contact-rail on a level with the surface of the track, said conduit being also provided with a conductor situated in the bottom of the conduit and in proximity to said contact-rail.

575,354. ELECTRIC RAIL BOND; W. Jens, Johnstown, Pa. App. filed June 30, 1896. In a rail bond, a portion of metal similar in nature to the metal of the bond-bar integrally united to the rail and adapted to have the bond-bar attached thereto.

575,366. ELECTRICAL CONTROLLER; W. H. Morgan, Alliance, O. App. filed Sept. 4. 1895. The combination with a frame, of a variable resistance therein, a shaft mounted in the frame, a switch-arm for said variable resistance secured to said shaft, a series of contacts mounted on the frame, a hub mounted loosely on the shaft, a series of switch-arms radiating from said hub and co-operating with said contacts to produce a reversing switch, a bifurcated arm projecting from said hub, a pivoted lever, a pin on said lever, co-operating with said bifurcated arm to operate the reversing-switch, a pinion carried by said shaft, and a rack on the lever, co-operating with said pinion to operate the switch-arm of the variable resistance.

575,388. RAIL-BOND AND CONNECTION; M. K. Bowen, Chicago, Ill. App. filed Oct. 9, 1895. A rail-bond comprising a conductor of relatively small cross-section with one end cut away so as to form an inclined surface, said conductor provided with a lateral projection near the end thereof, a large portion or end normally separate from said bond and provided with inclined surfaces, the two adapted to engage each other when forced together within the walls of the web of the rail, so as to form a bond of relatively small cross-section having enlarged ends in contact with the rail.



No. 575,394.—Magneto Telephone.

575,394. MAGNETO-TELEPHONE; S. D. Field, Stockbridge, Mass. App. filed Aug. 11, 1896. A magneto telephone comprising in combination a diaphragm, a magnet, a pole-piece therefor, and two oppositely wound or connected magnetizing or exciting helices of equal magnetizing power, but dis-similar inductance, associated with the said pole-piece, the said helices being in parallel or multiple arc with one another between the instrument terminals, and adapted thereby to be connected in parallel in the same working circuit.

575,419. TELEGRAPHY; P. B. Delany, South Orange, N. J. App. filed April 21, 1896. In an automatic transmitter, adapted to be operated by a prepared tape or ribbon to send successive signaling impulses into the line, the combination of contact devices controlled by the tape, to make and break connection of the battery with the line and to close the circuit of the battery after the passage of the tape, a main battery and means for automatically preventing the short-circuiting of the battery at the transmitting station when the transmission of the message is completed.

575,449. TELEGRAPH BATTERY JAR; A L. Werner, Delano, Pa. App. filed June 29, 1896. A battery jar provided with an integral spout and having its rim formed into outwardly-projecting hand-grasp flanges which extend almost completely around the jar but leave a blank portion.

575,454. SERIES MULTIPLE CONTROLLER FOR ELECTRIC MOTORS; E. M. Bentley, Lawrence, N. Y. App. filed Nov. 13, 1896. A series multiple controller for electric motors, comprising a shunt for the two motors containing a resistance, an automatic circuit-breaker placed in the series circuit between the two inner terminals of the shunts and dependent on the volume of current passing therein.

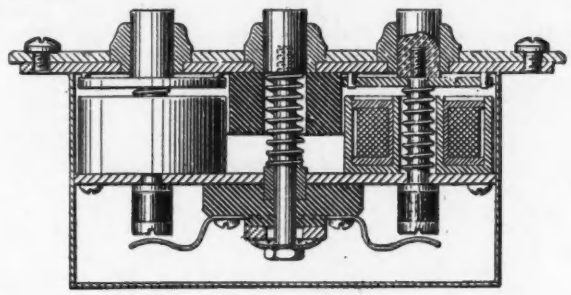
575,479. ELECTRIC ELEVATOR OR HOISTING MACHINE; R. M. Hunter; Philadelphia, Pa. App. filed April 5, 1894. In an electric elevator or hoisting apparatus, the combination of a vertically moving cage or elevating device, power devices for raising or lowering the same, and an electric motor mechanically connected to operate the power device and receiving current from a source of electrical energy, with a counter E. M. F. regulator consisting of electric conductors in series with the motor, moving in a magnetic field and provided with flexible means to vary the speed or movement of the said conductors extending to and controllable from the cage or moving part of the elevator or hoisting apparatus.

575,488. FLOATING TRACTION DEVICE; T. P. Milligan, Cambridge, Mass. App. filed March 26, 1896. In a towing device, a rail adjacent to the surface of the water, a boat carrying a suitable motor, a traction device connected with the motor and provided with rolls arranged to grip the rail, and a suitable connection for towing the load.

575,499. MEANS FOR OPERATING ELECTRIC MOTORS; J. F. McLaughlin, Philadelphia, Pa. App. filed Sept. 1, 1891. The combination with an electric motor, of a clutch for coupling it to the work, a brake for the motor armature, and connections between the clutch and armature-brake for operating them in succession.

575,523 PUSH BUTTON; C. O. Mailloux, New York, N. Y. App. filed June 4, 1896. The combination of the contact mechanism in a push button or a collection of push buttons, a case enclosing the same, the circuit-terminals located exteriorly to said case, and a removable face-plate covering said terminals,

575,573. ELECTRICAL CONTROLLING APPARATUS; O. H. and A. F. Pieper, San Jose, Cal. App. filed Dec. 19, 1895. In an electric motor controlling apparatus the combination with the main containing case, of a vertical spindle, a fixed switch-bar on said spindle, a series of contacts surrounding the spindle, contact-segments whereby an integral brush short short-circuits the armature-terminals when approaching the central position.



No. 575,523.—Push Button.

575,601. RAILWAY SIGNAL; W. F. French, Omaha, Neb. App. filed April 23, 1896. In a railway signal, the combination of contact plates yieldingly mounted for linear movement in alignment with each other and provided with resilient means whereby their movement in a common direction is resisted, and a tread operatively connected with one of said contact-plates and arranged in the path of car-wheels, whereby, when the tread is encountered by a wheel the contact-plate connected therewith is moved into contact with the other plate against the tension of resilient means, and the second contact-plate yields to cushion the movement of the parts.

575,615. ELECTRIC MOTOR AND DEVICE FOR CONDUCTING CURRENTS THERETO; D. N. Osyer, Newark, O. App. filed Oct. 17, 1889. In a system of electrical distribution the combination with the positive and negative conductors of an insulating-support, brackets secured thereto for the conductors respectively, and reversible holders interposed between the conductors and the brackets and detachable from the conductors.

575,641. WIRE COUPLERS; W. Gerard, St. Bernard, and J. H. Lawrence, Bond Hill, O. App. filed No. 23, 1896. A wire coupling consisting substantially of a sleeve having two bores, one entering at each end and both centrally in line with each other, each of said bores being substantially of one dimension in one direction or plane, while in the other they become wider, forming two walls diverging toward the inner ends of the sleeve, and two serrated jaws with flat backs in each bore, occupying, when a wire end is introduced, the space at each side of the latter and between it and the walls against which latter they lie with their flat backs.

575,653. ELECTRICAL CONDENSER; J. C. Lee, Brookline; W. R. Westcott, Cambridge, and E. C. Robes, Medford, Mass. App. filed July 8, 1896. The improvement in the art of manufacturing electrical condensers, which consists in winding strips of material constituting the plates, such as metal foil, and of the dielectric, such as paraffined paper, in alternating layers into a flat roll; in heating the roll for a suitable time at a temperature sufficiently high to drive off moisture and to soften the dielectic without injuring the same; and in subjecting the roll to pressure great enough to compress into a flat, rectangular solid having rounded ends.

575,658. GALVANIC ATTACHMENT FOR EYEGLASSES; A. Mayer, New York, N. Y. App. filed June 3, 1896. In eyeglasses having a galvanic attachment, a means for producing a main therapeutic circuit through a portion of the body in combination with means for producing one or more local circuits at the metallic terminals of said main therapeutic circuit.

No. 575,668.—Illuminant for Incandescent Lamps.

575,668. ILLUMINANT FOR INCANDESCENT LAMPS; A. de Lodyguine, Pittsburg, Penn. App. filed April 10, 1894. The method of forming illuminants for incandescent lamps, which consists in imparting the desired shape to a conducting-fillit, immersing said fillit in a mixture of hydrogen and a gaseous chlorin compound of a refractory metal and heating the fillit while so immersed.

575,679. MAGNETIZING BOX; C. A. Hussey, New York, N. Y. App. filed Aug. 10, 1895. A containing case, box or receptacle, having a metallic bottom and magnetized upturned ends, adapted to magnetize an article placed in the box.